SOCIAL RETURNS TO EDUCATION IN THE REPUBLIC OF MAURITIUS

BY

SANMUKHIYA CHINTAMANEE

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Abstract

This is the first attempt to estimate social returns, by which is meant pre-tax wage gains, to education in the Republic of Mauritius. Social returns are estimated for both sexes, by gender, by private and public sectors, and by rural and urban areas. This study uses cross sectional data from a sample of the 2000 Population Census. Although Psacharopoulos along with other researchers have estimated returns to education for many countries, the Republic of Mauritius had not so far been included due to lack of data prior to 2000.

The Mincerian approach is used to estimate social returns for the Republic of Mauritius, using the Ordinary Least Squares (OLS) method. All wage equations are adjusted for selectivity bias. Findings are similar to those reported in the literature. First, there is evidence of diminishing marginal returns to education when the social return to a year of education is estimated. Second, when highest academic qualifications are considered, tertiary education yields the highest social return relative to no schooling at all or to primary schooling only. Third, social returns to academic and vocational qualifications are higher for women than for men, a finding consistent with those reported for other countries and attributed to women's lower foregone earnings. Fourth, social returns to high level academic qualifications ('A' level and above) and vocational qualifications are higher in the private sector than in the public sector. Fifth, social returns are higher for those who reside in urban areas. Sixth, selectivity bias is minimal in most cases.

This study also uses the instrumental variable (IV) approach to deal with the omitted variable bias, endogeneity of schooling and measurement error. The 1976 free secondary education law is used as an instrument. This instrument only predicts the schooling of women for the Republic of Mauritius. IV estimates are consistently higher than OLS estimates. Implications of these results are discussed.

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Chapter 1: Introduction

1.0 Objectives of the current study

The purpose of this study is to estimate the social returns to education in the Republic of Mauritius[1] and to eventually supplement existing returns to education studies conducted elsewhere (Psacharopoulos, 1973; Psacharopoulos, 1985; Psacharopoulos, 1994; Psacharapoulos & Patrinos, 2002; Psacharopoulos, G. & Ng Y. C., 1994). This is the first attempt in the Mauritian context to estimate social returns to schooling and to different qualification levels. This thesis will therefore act as pioneering work for future researchers to carry out rate of return analysis for the Republic of Mauritius which will take into account costs of education and net incomes of individuals.

This study uses national level representative data. All results are derived from cross section data based on a 1% sample of the 2000 Population Census data. This is a survey which is made every ten years[2]. The data generated from this census is micro data at the household level and provides detailed information about each individual, for instance,

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[1] The Republic of Mauritius is an island group consisting of the island of Mauritius, a smaller island Rodrigues and a group of inhabited outer islets. The Republic has a democratic system of government based on the British pattern and a system of education, which also emerges from the British educational system.

[2] Except for the population census which was due in 1941 but was eventually postponed to 1944 because of the Second World War (CSO, 2002a). The Population Census 2000 as compiled by the Central Statistics Office (CSO) of the Republic of Mauritius, is the seventeenth for the islands of Mauritius, Rodrigues and Agalega.

occupation by industry, gross incomes from all sources, age, labour market experience and gender. No information about individuals' incomes was collected prior to 2000 so this census provides the first opportunity to estimate return to education in the Republic of Mauritius.

Social returns give the return to society when an individual completes an incremental education program. These indicators are useful to educational policymakers, for example, a comparison of social returns across the different levels of education will enable them to improve efficiency by reallocating resources across different levels of academic qualifications. Thus, this PhD, not only makes significant contributions to the existing literature on returns to education, but will also contribute to improving efficiency in the provision of education in the Republic of Mauritius, which is a developing country where resources are very scarce.

This PhD also estimates the patterns of social returns for men and women separately for different qualifications such as vocational and academic. As will be reported later in Chapter 5, social returns are relatively higher for women, telling policymakers that education plays a more important role for women in the Republic of Mauritius. Comparisons of social returns across private and public sectors are also made and the implications discussed. Insights into the differing characteristics of public and private sector employees and the resulting social returns are also provided. This will highlight the need (if any) of these sectors to revise their wage policies.

Also some researchers are concerned by over expansion of educational investments. An examination of the reported social returns generated by this study will reveal whether or not the Republic of Mauritius needs to be concerned by its level of investment in education, especially after the considerable investments made recently in setting up many secondary schools and the expansion of its existing tertiary education institutions. As will be deduced in Chapter 5 and Chapter 6, there are high social returns to high qualification levels in the Republic of Mauritius and these may be explained through the Skilled Biased Technology Change theory (Chapter 2).

Finally this PhD looks at the returns generated within the Republic of Mauritius in relation to other countries, with similar years of schooling and levels of GDP, and an investigation is also made to check whether or not the law of diminishing returns applies in its context.

Below I set out the limitations of this research along with the research questions.

1.1 Limitations of study

As discussed in Section 1.0, the Human Capital Theory hypothesises that education makes individuals more productive, leading to higher earnings. Education is, thus, an investment of current resources in exchange for future returns. According to Psacharopoulos (1995) there are three important methods of calculating rates of returns namely: the algebraic method, the short cut method and the earnings function method. Each of them brings specific advantages and disadvantages to the researcher. However, the most widely used method is the Mincerian earnings function. The more complete method, as argued by Moock et al (1998), is the net earnings profile method where detailed age-earnings profiles by the level of education are used and the rate of return is computed as the discount rate that equates the present value of the stream of education benefits to that of the stream of educational costs. This is computed as follows:

$$\sum_{t=0}^{n} \frac{B_t}{(1+r)} = \sum_{t=0}^{n} \frac{C_t}{(1+r)}$$

where B_t and C_t are the benefits and costs of that particular educational investment (for example, completing upper secondary education following the completion of lower education) in year t while n is the expected life of the investment, and r is the internal rate of return. The benefits are measured as the extra average additional earnings received by an individual following his/her decision to have an extra year of schooling.

The costs of the investment in education include both direct and indirect costs. The direct costs comprise of all expenditures related to school attendance and the full resource costs of providing the educational service (such as any subsidised costs not borne by the individual) while the indirect costs are the average foregone earnings as a result of the investment decision.

Thus, any cost-benefit analysis requires both the direct and indirect costs to be weighted against the likely benefits before rates of return may be computed. Rate of return is split into two components: the private rate of return (PRR) and the social rate of return (SRR). Private rates of return just include those costs that are borne by the student (or their family) and those benefits that flow to the individual. Social rates of return, on the other hand, also include those costs and benefits that accrue by the rest of the society (particularly the taxpayer). The gap between the private rate of return and the social rate of return helps the government in resource allocation, for instance, if PRR exceeds SRR for a particular level of education, it implies that a government reducing its spending on that particular level of education would be socially efficient. It will not result in individuals investing in less than the socially optimal amount of education. However if SRR exceeds PRR, then the government may increase its spending on that particular level of education, for instance, primary schooling has been repeatedly reported to generate higher SRR relative to PRR (Psacharopoulos & Alam, 1991; Psacharopoulos & Ng, 1994; Psacharapoulos & Patrinos, 2002).

Moreover, to calculate the private rate of return, all resources invested by the private individual such as the opportunity costs and direct costs are required while social rate of return calculations include the public cost of education. In theory the private and social rates of return must include the monetary and non-monetary benefits of education. The private benefits of education, for instance, are higher wages for educated individuals over the less educated over their working lives. Other benefits include the consumption aspects, that is, enjoyment while being at school (Menon, 2003). The social rate of return must include the monetary value of an external benefit. Some examples of such a benefit would be the increased productivity of others as a result of the educated individual and an environment suitable for research and development. Other studies report benefits of education which include reduced family size, better health, political awareness, and improved child care (Schultz, 1988; McMahon, 1995).

It is argued that the non-monetary benefits are potentially large and, thus, a measure of the total effects of education is desirable. However in practice most studies do not include external benefits in the calculations of social rates of return due to data limitations. Similarly the available micro data at household level for the Republic of Mauritius does not provide enough information for such comprehensive returns estimation and no information about costs is available, making it impossible to use cost-benefit analysis. Thus, the present study focuses on only the monetary returns to education in wage employment. The model that will be used throughout this study is the human capital earnings function, as developed by Mincer (Mincer, 1974; Mincer, 1980):

$$\ln Y_i = \alpha + \beta S_i + \gamma_1 EXP + \gamma_2 EXP^2 + \varepsilon_i$$

where S_i is the number of years of schooling of individual i, EXP_i and EXP_i^2 are labour market experience and its square. Thus, given the absence of cost data, this Human Capital Model will be used but it will incorporate some modifications to fit the actual data set. This earnings function method is discussed at length in Section 5.1 of Chapter 5.

Another limitation is that this study uses cross-sectional data which combines cohorts who have gone through different schooling cycles and employment experiences and not panel data that follows an individual over a certain period of time, making it difficult for the researcher to address any change in educational quality.

Ideally it would be better if private returns and social returns could be estimated for each qualification because the difference between the private and social returns can act as policy indicators. The gap between these estimates act as signals to policy-makers as to where to invest more (when social returns exceed private returns) and when to transfer part of the educational expenditure onto the student or their parents, that is, reduce the public subsidisation of education (when social returns are much lower than private returns). However the 2000 Population Census data set does not separate wages from other sources of incomes before taxation, and costs of educational investments are also not available. Thus, the main aim of this research is to only generate gross returns and not private or social returns to different qualification levels for the Republic of Mauritius.

Nevertheless, the empirical fitness of the Human Capital Theory (HCT) in explaining earnings differentials in an upper-middle income country may still be tested through earnings profiles. Also testing the HCT may provide useful insights into whether or not expanding a particular educational level would exacerbate earning inequality and how to address the inequality problem best. Moreover this study will help in understanding how the Mauritian labour market functions. Labour market conditions will be highlighted when returns between the public sector and the private sector, between male and female employees, and between rural and urban areas are compared. Thus, a number of hypotheses may be tested using the 2000 Population Census data and these hypotheses are set out in the Section 1.2:

1.2 Research questions

The importance of human capital theory has been constantly reaffirmed (Psacharapoulos, 1985; Psacharopoulos & Hinchliffe, 1973; Psacharopoulos, 1994; Psacharopoulos & Patrinos, 2002). Psacharopoulos uses the semi-log (Mincer-type) earnings functions and estimates the co-efficients on years of schooling, and his models generally include explanatory variables such as years of schooling, experience and experience squared. He estimates the returns to schooling for over 61 countries and he reports a pattern of declining returns to education by years of schooling. In other words if education is treated as any other investment, educational expansion is subject to the law of diminishing returns. Moreover he reports that as a country moves from a less developed status to a more developed one, the returns to education tend to decline. However these declines are relatively minor implying that the returns to schooling are relatively stable over time (Psacharopoulos & Patrinos, 2002). Also private returns to higher education exceed social returns to higher education across all countries irrespective of the level of economic development (Psacharopoulos & Patrinos, 2002: Table 2). Thus, given these empirical findings and due to the limited information provided by the 2000 Population Census data set, the current study aims to answer the following research questions:

- Is there evidence of diminishing returns to investment in education for the Republic of Mauritius?

It is hypothesised that as an individual acquires more education, the law of diminishing returns sets in, that is, social returns to primary schooling are much higher than those for secondary schooling and social returns to tertiary education are lower than those for secondary schooling.

- Do women in the Republic of Mauritius have higher social returns than men?

Other studies, as will be discussed have reported that females have relatively lower foregone earnings as reflected by their low gross incomes. They enjoy higher returns than males and education appears to play a more important role in determining the gross incomes of women.

- Do social returns vary between the public and private sectors within the Republic of Mauritius?

The returns to qualifications may be higher in the private sector than in the public sector due to the productivity enhancing role of education in the private sector rather than the prevailing signalling role of education in the public sector. Siphambe (2000), for instance, argues that productivity, experience and unobserved individual influences such as efforts, are more important in the private sector and that wages are less tied to productivity in public sectors.

However this thesis does not address the signaling value of education but explores the differences that exist in the social returns enjoyed by public and private sector employees after taking into account relevant factors such as age, gender, tenure and level of qualifications.

- Do social returns vary by rural and urban areas in the Republic of Mauritius?

It is hypothesised that those who live in urban areas enjoy higher social returns relative to those who live in the rural areas. This is explored in this thesis.

Unfortunately the data cannot address the following empirical questions:

- Given that education at all levels is free[3] in the Republic of Mauritius, do private returns to all qualification levels exceed the social returns to all qualification levels? Since the only measure for wages is total income from all sources before taxation, private returns to education cannot be computed and thus, the difference between social and private returns cannot be investigated.

[3] Except for MA, MSc and PhD courses, although these are subsidised by the government

- Do Mauritians from less privileged backgrounds experience lower returns to all qualification levels? This hypothesis cannot be tested as data on the socio-economic background of the respondents are not adequately provided.
- Have returns to education varied over time? As the Population Census of 2000 was the first census to have a question on income it is impossible to examine how the returns to education varied over time within the country. Similarly, hypotheses about time trends in the returns to education, depicting an improvement in returns to qualifications for women cannot be tested.

1.3 Methodological issues

Methodological issues include dealing with the problems of selectivity bias, omitted variables bias, endogeneity of schooling and measurement error. It is argued that in the presence of these methodological issues, the conventional OLS would generate biased estimates to social returns. These are discussed at length in Chapter 2 but for the purpose of this chapter, I outline how I tackled these problems in order to generate estimates of social returns to education that are consistent.

I attempted to generate consistent estimates to social returns to a year of schooling and to different highest qualification levels. I first use the

Mincerian method to generate conventional OLS estimates. However the problem of selectivity bias arises because the Mincerian wage equation is defined for a subset of individuals which has been non-randomly drawn from the overall population. It is possible that the characteristics of men and women employed and unemployed differ and in this case, OLS regression analysis leads to inconsistent estimates. Thus, I used the Heckman two-step procedure to obtain social returns that are free from selectivity bias.

I used the Instrumental Variables approach to deal with the other problems: the omitted variables bias given that the 2000 Population data set do not provide adequate information on individuals' abilities; the endogeneity of schooling because more able individuals may choose to stay at school longer; and finally, to correct for measurement error. This approach requires the use of some instrument that is correlated to the schooling decision but does not affect earnings outcomes directly. For the purpose of this thesis, I use the 1976 free secondary education policy as an instrument given that it predicts schooling in the cases of women[4] but not their wages.

Thus, being fully aware of the dangers of producing inconsistent estimates, I report, in this thesis, social returns to an extra year of

[4] This is discussed in Chapter 6.

schooling and to the highest qualification levels which do take into account these methodological issues.

1.4 A note of caution.

Human Capital Theory assumes that through education people acquire attributes that make them more productive in the labour market (Mace, 1992) and that wages may be used to measure productivity. However according to the screening hypothesis, 'the educated enjoy higher earnings because education acts as a filter or screening mechanism, and not from an increase in productivity resulting from additional education' (Menon, 2003; p. 373). In its strong version, the screening hypothesis invalidates rates of return analysis, and this can have devastating implications for policy makers. This implies that the provision of education throughout the world entails considerable subsidies to students without adding anything to the productive capacity (Mace, 1992). But in its weak version, the screening hypothesis can be reconciled with the Human Capital Theory as the latter postulates that employers do use education as a screening device and they associate skills and abilities of the educated with their attainments in education. Thus, the effect of education on productivity need not be questioned (Psacharopoulos & Woodhall, 1985). The underlying theory for this thesis is Human Capital Theory.

Rate of return analysis is a popular tool among policy makers. It is used to understand and compare the returns on one investment to the returns on another. I follow some of the rates of return studies conducted elsewhere in the world to estimate values of social return to education in the Republic of Mauritius. In the absence of an alternative measure, gross income is used as a proxy for productivity in this thesis and gross wage premiums are computed.

Policy makers must understand that rates of return studies do not yield perfect measures of the profitability of educational investment (Menon, 2003). They need to be aware of the limitations of rates of return analysis, for instance, in this thesis, due to the lack of data, social return estimates do not capture the non monetary benefits of education when these have been reported to be considerable in the literature. Social returns in this thesis are gross returns or wage gains arising from the individual's decision to acquire a particular qualification level. The social return values, thus, generated here must be viewed as gross indicators of the economic value of education. In the absence of alternative measures, these will provide valuable input to education decision making in the future. These would enable policy makers to make informed decisions about the allocation of resources across the education system in the Republic of Mauritius.

1.5 Structure of thesis

The rest of this thesis is structured as follows:

Chapter 2 is organised into three major parts. The first part evaluates the underlying theoretical framework for this thesis, that is, the Human Capital Theory. This is also discussed in relation to Spence's (1973) Job Market Signalling Theory. The second part highlights the need to produce consistent estimates. I provide an in-depth explanation about the methodological issues surrounding rates of return analysis which include the need to correct for ability bias, endogeneity and measurement errors. The use of IV approach is advocated as an alternative to the OLS technique and I also highlight the fact that returns to education can be heterogenous. The third part provides empirical evidences on the rates of return studies conducted elsewhere in the world. However I focus only on those studies that are most relevant to the context of the Republic of Mauritius.

The purpose of Chapter 3 is to briefly review the whole education system of the Republic of Mauritius. Expenditure on education as a proportion of GDP is reported, the mechanics of promotion to the next grade in the primary and secondary schooling cycles are explained and the basis on which students are allocated to academic and vocational streams are discussed. I lay particular emphasis on efficiency and equity issues for the education system of Republic of Mauritius by referring to drop-out and survival rates. These will eventually serve to inform recommendations for educational planners and policy makers in Chapter 7.

Chapter 4 is split into two major parts. The first part presents the 2000 Population Census data set and issues about validity and reliability of the sample used are addressed. Some main variables that are used throughout this study are discussed at length. The second part provides some descriptive statistics combined with test statistics so that the reasons behind earnings differentials may emerge.

Chapter 5 provides the first set of results for the analysis carried out for the purpose of this thesis. OLS estimates to social returns to highest qualification levels in the Republic of Mauritius for the combined sample of men and women, by gender, by private/public sectors and by rural/urban areas are presented and the implications discussed. Initially, only conventional OLS estimates are presented. But later in an attempt to produce estimates that are free from censoring bias, the issue of sample selection bias is addressed through the Heckman selection model. These results are also presented and discussed for each group of the sample.

Chapter 6 makes another original contribution to the existing rates of return studies. The instrumental variable approach is applied in the context of the Republic of Mauritius. Following other studies, an attempt to use changes in the supply side is made. The possibilities of using two pieces of educational legislation: the 1993 basic compulsory schooling law and the 1976 free secondary education law as instruments are explored. The IV approach is used to generate consistent estimates in the presence of omitted variables, endogeneity of schooling and measurement error. Again IV estimates to social returns are presented and discussed for men and women combined, by gender, by private/public sectors and by rural/urban areas.

Chapter 7 concludes this thesis by first giving an overview of what this thesis contains, then highlighting the major findings and finally making recommendations for policy makers. The need for policy makers to use all findings reported here, cautiously and to supplement these are also emphasised.

Chapter 2: Theory and evidences on rates of return throughout the world

2.0 Introduction

The underlying theory of this thesis is Human Capital Theory and in this chapter, I examine some studies that have used rates of return analysis. Human Capital Theory hypothesises that education makes individuals more productive and that this yields higher earnings and hence a positive return is derived on the investment made in that person's education (Menon, 2003).

Private rates of return provide an explanation for trends and changes in the private demand for education. Private rates can thus be used to help policy makers to understand and predict demand. These can be used on issues such as social equity and student loans (Psacharopoulos, 1992). Social rates of return are used to determine the profitability of educational investment and comparisons are made to find whether educational investment is preferable to investment in physical capital or among various educational projects (Menon, 2003).

Numerous studies have been conducted throughout the world to estimate the returns to education, using a variety of methodologies. According to

Psacharopoulos (1995) there are three important methods of calculating rates of returns namely: the algebraic method or the internal rate of return, the short cut method and the earnings function method. Each of them brings specific advantages and disadvantages to researchers. But the fact that it is difficult to measure the benefits and costs of education accurately must be acknowledged and the results of rates of return analysis must be interpreted carefully. Other objections to the use of rates of return analysis are raised because of data constraints, cross sectional profiles, consumption benefits, uncertainty, and the fact that education is not the sole factor that contributes towards higher earnings (Mace, 1992).

Severe problems may be encountered when carrying rates of return analysis, especially in some developing countries where there is shortage of data required to make rate of return calculations. Also the use of cross-sectional data, which is based on a snap-shot, does not represent the trend of the individuals' earnings over the course of their working lives.

Investment in education is not restricted solely to investment for future returns. It includes the desire to consume education now (Menon, 2003). Calculations of private rate of returns assume that all educational spending is for investment purposes so that future earnings may rise. Nevertheless individuals do not spend on education for future benefits only. They also want to derive enjoyment from participating in education. It is practically impossible to measure the amount of educational spending for consumption purposes because that amount will differ for each individual. Besides this, educational expenditures may give rise to a sense of well-being or an improvement in the quality of life (Mace, 1992). But these are not captured in the rate of return calculations. Only increased salaries are considered to be the benefits to education. Thus, since these consumption benefits are excluded from the rate of return analysis, the calculation will underestimate the return to individuals.

As mentioned earlier, the social rate of return calculations use observed wages as being a 'good' proxy for the marginal product of labour. It is assumed that the economy is competitive. Thus, even if data for individuals who work in the private sector of the economy are considered, it may not reflect the true value of marginal productivity of labour. In some countries, especially in Africa, the government controls the private sector and people are paid according to the scale set by the government (Blaug, 1967). So people may be paid below or above what they actually produce. A further difficulty arises with the existence of an informal economy. Whether or not the imperfections in the market invalidate rates of return analysis, depends on the extent to which wages may be used as a proxy for marginal productivity and whether labour markets are sufficiently competitive to allow earnings to move up and down to reflect market forces (Mace, 1992).

The basic idea is that individuals are rational and will undergo additional schooling only if sufficiently higher earnings compensate the costs. However the rate of return analysis which is based on the earnings of a large number of individuals, cannot make any allowance for the uncertainty faced by an individual, for example, the uncertainty faced by a generation of students would be less than what students on their own would face. They may be uncertain about the earnings they expect either with or without the extra year of schooling, about being able to stay at work throughout their lifetimes or even about their chances of surviving up to retirement age (Mace, 1992). In some countries, women move out of the labour force for a certain period of time without knowing whether they can go back to work or when they can join the labour force again. All these factors make it difficult to visualise the age-profiles of individuals as a single line. Instead it may be conceptualised as a zone, with a higher density at the centre but also with a very considerable spread over time to reflect the greater uncertainty of the more distant future.

The extent of the external benefits may be large. Usually we tend to associate more education with less crime. For example, Lochner (1999) found that a significant relationship between higher rates of high school participation and tougher penalties had the lowest index for property crimes while ability and high school graduation significantly reduced the participation of young men in crime and rates of incarceration. His study was based upon large scale US micro datasets and he developed a model whereby education was correlated with crimes that required less skill. According to him education affects factors such as unemployment and inequality. Leigh (1998) claims that there is a strong and positive correlation between increased education and the absence of violent crime, measures of health, family stability and environmental benefits. Thus, other more indirect effects of education may be possible, for instance, according to Gemmell (1996), education may also provide positive production externalities whereby the educated workers in a firm may not only be more productive themselves but may also enhance the productivity of their less-educated colleagues. Although these economy-wide educational spill-overs exist, it is difficult to actually verify their size and calculate their true social returns.

Also as highlighted by the Signalling Theory, education may not always add to productivity. In the extreme case where education only acts as a screening device for employers, education does not add to productivity at all and the net contribution to national output may be negative (Mace, 1992). However, available evidence runs counter to the above argument (Boissiere et al, 1985; Lambropoulos, 1992; Psacharopoulos, 1987; Psacharopoulos, 1989; Psacharopoulos, 1996) and thus, rates of returns analysis are still used as a planning and policy tool in education (Menon, 2003).

Despite all these objections, rate of return analyses are still widely used because it is easy to understand and enables comparisons with various other forms of investments. However these can only act as gross indicators to inform policy-making and need to be supplemented. Similarly in this thesis I can only compute gross wage premiums to an increase in educational attainment and these are only approximations to social returns. The most widely used method to calculate returns to education, is the Mincerian earnings function and the standard method used to estimate any regression is the Ordinary Least Squares (OLS). But due to various shortcomings of the OLS technique, researchers often turn to the Instrumental variables method. In this chapter, I examine its use and the advantage it has over the conventional OLS method. However the Instrumental variables method is discussed at length in Chapter 6.

The rest of this chapter is organised as follows:

Section 2.1 provides the theoretical aspects of the rates of return to education. Sub-section 2.1.1 outlines the underlying theory for this PhD while I move on to discuss the signalling value of education where I focus largely on Spence's (1973) model in Sub-section 2.1.2. This adds a cautionary note to the use of wages as a measure of productivity. The concept of skill-biased technological change (SBTC) is outlined in Sub-section 2.1.3 to highlight the importance of technological change in promoting demand for skilled workers and to justify the stable returns to education following educational expansion.

Section 2.2 looks at some methodological issues and reminds us that the conventional OLS method may yield biased estimates. I address each of these methodological issues in separate sub-sections. Sub-section 2.2.1 provides the rationale as to why it is important to deal with the problem of omitted variables bias. The importance of correcting for endogeneity and measurement errors issues is highlighted in Sub-section 2.2.2. The Instrumental Variable approach is then introduced as an alternative to the Conventional OLS method in Sub-section 2.2.3. The need to address heterogeneity in returns is pointed out in Sub-section 2.2.4.

Section 2.3 presents some empirical evidence on the rates of return to education. The main findings on returns to education throughout the world are presented in Sub-section 2.3.1, for instance, by addressing the effects of educational expansion on the returns to education and tackling the issue of whether or not educational investment has caused a decline in the rates of returns. I analyse some studies conducted by Psacharopoulos (1973; 1980; 1985; 1994; 1995; 1996) and I also present Bennell's (1994;

1996) reviews of the validity of these studies. Then I discuss two studies in depth which support the SBTC theory in Sub-section 2.3.2. I look at two studies: one conducted by Machin & Van Reenen (1998) and the second one by Berman & Machin (2000) in an attempt to assess the empirical evidence in favour of the SBTC hypothesis and to briefly incorporate the concept of technological transfer from high income countries. This theory proves particularly useful when I have to justify the existing high returns to education that prevail in the Republic of Mauritius in Chapter 7. I move on to discuss the issue of omitted variables bias in the Sub-section 2.3.3. I examine the empirical study conducted by Griliches & Mason (1972). This study points out how the schooling coefficient may be overstated if ability and school quality measures are omitted from the analysis. It also deals with how the ability measure may be included in the regression analysis. Endogeneity and measurement error issues are addressed in Sub-section 2.3.4. I focus on three studies that use a particular instrument of interest, namely Pons & Gonzalo (2002), Harmon & Walker (1995) and Dearden (1999). These studies illustrate how one can produce consistent estimates of the return to schooling even in the presence of measurement error and endogeneity of schooling. In Sub-section 2.3.5, I discuss empirical evidence around the heterogeneity in the returns to education by referring to three studies conducted by Harmon et al (2000), Dearden (1999) and Koop & Tobias (2004). Each study uses different data sets. I present some empirical evidence on returns to education for vocational education in Sub-section 2.3.6.

Finally I conclude this chapter by highlighting how these studies influence the subsequent estimation of the returns to education in the Republic of Mauritius.

2.1 Theoretical aspects of rates of return to education

2.1.1 The human capital framework

The theory underlying this study is Human Capital Theory pioneered by Mincer (1962) and Becker (1964). The model hypothesises that wages are determined by the stock of human capital and the allocation of time to the labour market (Horowitz & Schengzler, 1999). In this section, therefore, I outline what Human Capital Theory is.

Education is an investment of current resources in exchange for future returns. These current resources may include both the direct costs and the opportunity cost incurred while this investment is undertaken. According to Becker (1964), 's' years of schooling is chosen to maximise the expected present value of future incomes streams, up to retirement at date, T, net of the costs of education, c_s. Schooling is thus, an optimising investment decision based on future earnings and current costs: that is, on the (discounted) difference in earnings from undertaking and not undertaking education and the total cost of education including foregone earnings. Investment in education continues until the marginal cost of education equals the marginal return. The equations used by Harmon et al (2000) may be used to illustrate this equilibrium position:

$$\sum_{t=1}^{T-s} \frac{w_s - w_{s-1}}{(1+r_s)^t} = w_{s-1} + c_s$$

where r_s is the internal rate of return to the sth year of schooling.

In equilibrium the present value of the sth year of schooling just equals the present value of costs associated with that particular year of schooling and the internal rate of return, r_s gives the discount rate at which the equilibrium position is attained. It is the discount rate that equates the present value of the relevant streams of additional pecuniary benefits and costs. Thus, the financial pay off to an extra year of schooling can be quantified by computing its internal rate of return. (Fuente, 2003).

When making decisions about educational investments, one would compare the internal rate of return, r_s to the market interest rate, i and such investments would only be undertaken if $r_s > i$ making the investment worthwhile for the individuals. An individual who attaches more (less) value on current income than future income will have a higher (lower) discount rate and they are therefore less (more) likely to undertake educational investments.

Also if c_s, that is, the direct education costs is large then the net benefits of schooling fall, eroding the reward from undertaking education. However if c_s is sufficiently small and T is large then the equilibrium condition may simply be reduced to: $r_s = \frac{w_s - w_{s-1}}{w_{s-1}} \approx \log w_s - \log w_{s-1}$

Hence the return to the sth level of schooling may be obtained by the difference between the log of wages an individual is likely to earn after 's' years of schooling and the log of wages he/she would have earned had he/she chosen only 's-1' level of schooling. Basically the argument stressed here by Harmon et al (2000) is that the returns to education depend on how *log* wages vary with the level of schooling.

One of the major problems of calculating internal rates of return is data collection. Thus, to use this method, data on the earnings of a representative sample of workers classified by age, by educational level and by type of course taken are required. Also, data on their length of schooling, occupation, sex, social background, location of employment and measures of natural ability should be available; estimates of private expenditures on tuition fees, books, and so on are required and even the average income tax rates. Data requirements also include information on the labour market such as the rate of unemployment, the labour force participation by age, sex and educational level (Mace 1986). However in reality it is difficult for countries to keep this information and even if they do, the data are not collated in a way suitable for analysis but researchers still compute the rate of returns by filling in the gaps by making assumptions (Mace, 1992).

An approximation to this human capital theoretical framework is the earnings function popularised by Mincer (1974) whereby decisions about optimum educational investment are based on current costs and future earnings. Mincer's original formulation used data on 1959 annual earnings of white, non-farm, men in the USA. His model did not include any specific measure of the costs of education, although it does incorporate opportunity costs, i.e. earnings foregone, that are a high proportion of total costs. A basic empirical model can be written as follows:

$$\log w = a + bS + cE + dE^2 + e$$

where $\log w$ again represents the log of wages, S is the years of schooling, E is the years of experience and a is the constant whereas b, c and d are coefficients of their respective variables while e is an error term. Note that experience is included as a quadratic term to capture the concavity of the experience earnings profile. Again the returns to schooling can be estimated by analyzing how log wages vary with S as b measures the proportionate effect on wages of an increment to S. If an individual chooses an additional year of schooling, then his extra education would cause his wages (log w) to rise by the value of the co-efficient 'b' and this value is in fact the average private return, r_s to an additional year of schooling, assuming that tuition fees are zero and that foregone earnings are the only costs associated with that extra year of schooling. However we need to bear in mind that this co-efficient is only an approximation to the internal rate of return and only equals it under certain conditions – including the assumption of an infinite working life.

Instead of measuring returns to the overall schooling level, this equation can be extended to estimate the private returns to primary, secondary and tertiary education separately. To do so, it will require dummy variables which will be equal to one if the event occurred and zero, if otherwise. One way of rewriting the Mincerian function emerging from the human capital theoretical framework is as follows:

$$\log w_i = a' + b'S_{1i} + c'S_{2i} + d'S_{3i} + f X_i + gX_i^2 + e$$

where S_1, S_2 and S_3 are dummy variables representing different levels of education. For instance, if an individual has attended only primary school, then S_1 will take the value of 1 while $S_2 = 0$ and $S_3 = 0$. The private return to primary schooling can be calculated as $PRR_1 = b' / N_1$, the private returns to secondary schooling is given by $PRR_2 = c' / N_2$ and the private returns to tertiary education is given by $PRR_3 = d' / N_3$ where N_x denotes the number of years required to complete the xth level of education. In other words if an individual attended primary school between the age of 5 to 11 years, secondary school from the age of 11 to 18 years and if s/he chose a bachelor's degree which lasted for 4 years, then $N_1 = 6$, $N_2 = 7$ and $N_3 = 4$ and by deducing the values of the coefficients (b′, c′ and d′) from the regression model, the private returns to each level of schooling can be obtained (Johnes, 1993). However Psacharopoulos (1995) cautions us about the foregone earnings of primary school aged children, for example in his study, he assigned only three years of foregone earnings to this group. But different assumptions are appropriate for the opportunity cost of child labour in different countries or areas depending on the local economy and stages of development.

The extended Mincerian function including a number of additional variables can be rewritten as follows:

$$\log w_i = rS_i + X_i\beta + \delta E_i + \gamma E_i^2 + u_i$$

where w_i is the earnings measure for an individual , S_i denotes schooling , E_i measures labour market experience (to be calculated as age minus the age at which the individual left school) and finally X_i is a set of other variables which affect earnings. The quadratic term for experience is included to account for the concavity of the earnings profile. u_i, the disturbance term is assumed to be independent of X_i and represents other unobservable factors. To estimate this model consistently, we need to assume that there is no correlation between S_i and u_i, in other words that schooling is exogenous. These assumptions are necessary if we want to obtain an unbiased estimate of r. Further methodological issues, and the problematic nature of the assumption of exogeneity, are discussed later in this chapter.

The precise return to education is arrived at by Halvorsen & Palmquist (1978) by taking the antilog of the schooling coefficient minus one or simply (e^r-1). This adjustment is not required for continuous variables but is needed in specifications using dummy variables. The general form of any equation estimating returns to education containing both Z_i representing a set of continuous variables and D_i representing a set of dummy variables may be written as follows:

$$\ln Y = a + \sum_i b_i Z_i + \sum_j c_j D_j$$

Here the percentage effect of a small change in a continuous variable on Y may be obtained by multiplying the coefficient of that variable by 100. However the same cannot be done for dummy variables because if the event occurs (i.e. the factor is present) then the coefficient of that dummy variable measures its discontinuous effect on Y. So the relative effect of that dummy variable on Y is computed through exp (coefficient) – 1 and the percentage effect is given by $[(e^{\text{coefficient}}-1) \times 100]$. If this mathematical adjustment is not done, then there can be serious misinterpretations of dummy variables in semi logarithmic equations. For example, Hanushek & Quiley (1978) as cited in Halvorsen & Palmquist (1978) report that a postgraduate degree increases the earnings of a black worker by only 64% whereas the correct result should have been 90%. Siphambe (2000) interprets the returns to each level of education (primary, secondary and tertiary) for Botswana by first adjusting each of the coefficients of the dummy variables. However in most studies which have investigated the education-earnings relationship, this mathematical adjustment is not done. Similar to these studies, I report the OLS estimates to returns to education without making the adjustment for using dummy variables in the tables. However while discussing social returns to education in the text, I do refer to those returns for which the mathematical adjustments have been made and where the impacts on the magnitude of the social returns to education are substantial.

The extended version of the Mincer (1974) model is thus generally estimated by OLS and can include a number of explanatory variables that also determine wages, such as experience, age and so on. This allows the estimation of rates of return to education to be derived from simple cross sectional data. Indeed this type of model is the basis of many hundreds of research studies that have undertaken empirical estimations of the rate of return to education across a range of countries. Thus I will use this Mincerian model to derive social returns to qualifications for the Republic of Mauritius.

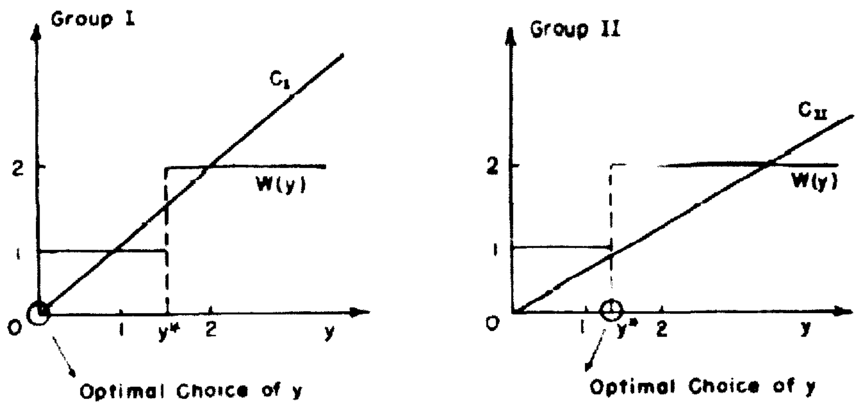
2.1.2 Signalling

According to the Human Capital Theory, returns to education are due to the fact that schooling augments productivity as valuable skills are learnt at school (Hartog et al, 1999). However, Wolf (2002) argues that 'earnings are a highly imperfect measure of an individual's 'productivity'' (p.28). Education may simply function as a screening or signalling device. Education signals the effect of ability on earnings and it is difficult to unravel the extent to which education is a signal of existing productivity or the capacity to enhance productivity. Either way there is a positive correlation between earnings and education although the reasons differ. The estimates of returns to education thus do not only reflect the productivity enhancing effect of education. Thus, according to Wolf (2002) education is a socially acceptable way of ranking, screening and selecting people without which employers would find it hard to hire employees.

Since education may not reflect productivity but instead may simply signal ability, the rate of return may not provide accurate estimates of the productive value of education. To illustrate the fact that education may simply act as a sorting mechanism, I use Spence's (1973) job market signalling theory. He argues that education may be used as a signalling device by job applicants when employers are uncertain about a worker's productivity and the information will not necessarily become available to the employer immediately after hiring. Here the employer is assumed to be risk-neutral and education is used to identify existing differences in worker productivity, rather than enhancing worker productivity. In the most extreme cases, it is argued that education does not have any social value, that is, it does not increase total output in the economy. Risk-neutral employers who do not have any information about the worker's productivity, will tend to pay a wage equal to the average productivity of the population. However employers know the level of education acquired by the individual and if education is assumed to be a good proxy for marginal product, employers will start offering higher wages for workers with more education, who are likely to have a higher marginal product. If better-educated people are more productive, then employers may use educational attainments to employ higher ability workers. An individual will invest in education if there is adequate return in terms of the offered wage. Education is a costly investment and these costs are referred to as signalling costs. For individuals to invest in different levels of education, signalling costs must be negatively correlated with productivity (Spence, 1973; Vignoles, 1998). The rationale behind this negative correlation is that more able individuals must be able to purchase the same amount of education as less able individuals at lower schooling costs. In other words for each and every wage offer, more able people will invest more in schooling than the less able and thus, the level of education provides accurate signals of productivity levels.

Employers hold conditional beliefs about productivity and if the employers conditional beliefs are not confirmed by observation of the workers employed, these conditional probabilistic beliefs will be adjusted and new entrants in the market will face a new wage schedule. The new wage schedule will cause individuals to adjust their investments in education accordingly. This process of revising conditional probabilistic beliefs as new market information becomes available to the employer through hiring and subsequent observation of the workers at work, will continue until the employer's conditional beliefs are confirmed. Workers will continue to invest in education until the marginal benefit from signalling is equal to the marginal cost. Spence (1973) illustrates this equilibrium, splitting the population into two groups: group 1 is a proportion q_1 of the population while group 2 is a proportion $1-q_1$ but both groups face the same employer. Workers in group 1 have a productivity of 1 while those in group 2 have a productivity of 2. The costs of acquiring education level y to any individual in group 1 is y whereas any individual in group 2 faces a cost equal to y/2. The employer believes that there is some level of education say y* such that y<y* where productivity is one with probability one and where y≥y*, productivity is two with probability one. Assuming that there are only two wage offers, individuals in each group will select the optimal levels of education. Individuals in group 1 will set y = 0 because if he invest in education and by the time he reaches y* there is no benefit, education is costly for him/her. Individuals in group 2 will set y = y* and increase their educational investments no further because there is no additional gain in terms of higher wage offer. The optimised choices of education for both groups are illustrated in Figure 1.

Figure 2.1: Optimal choice of education level



Source: Spence (1973, p.363)

Given the level of y* in the diagram, it is easy to see that group 1 will select y = 0 and group 2 will select y = y*. Here the employer's beliefs are confirmed and we have a signalling equilibrium. Here the employer's initial belief is confirmed by market experience provided that $1 < y^* < 2$. With signalling, group 1 will be worst off, as without it, they will be paid a wage equal to the average productivity of the population. With signalling the employer pays the higher wage only to those who are genuinely more productive (Vignoles, 1998). Hence education is helping to allocate the right people to the right jobs. But it should be noted that at extremes, education does not increase productivity levels and there is no gain in national output[5].

Hence in empirical estimates of rates of return analysis to education, it becomes important to control for ability and test whether education still has a strong effect on earnings – any likely difference is to be attributed to the signalling value of education.

There are other ways of assessing the signaling value of education. One way may be by looking at the education/earnings relationship for public sector versus private sector employees where the latter is supposed to be the competitive sector. Also in some studies, the returns to years of schooling in the public sector are assessed relative to those generated within the public sector and for those who are self employed. Hence, for

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[5] However there can still be a net social value due the improved information if this reduces employers' costs for search and post-hire selection for dismissal, sufficiently relative to the cost of education minus any consumption benefit of education.

instance, if public sector workers and those who are self employed have identical rates of return to years of schooling and this is exceeded by the rate of return in the private sector, this would support the productivity enhancing role of education as the private sector rewards the more educated workers (Gomez-Castellanos & Psacharapoulos, 1990).

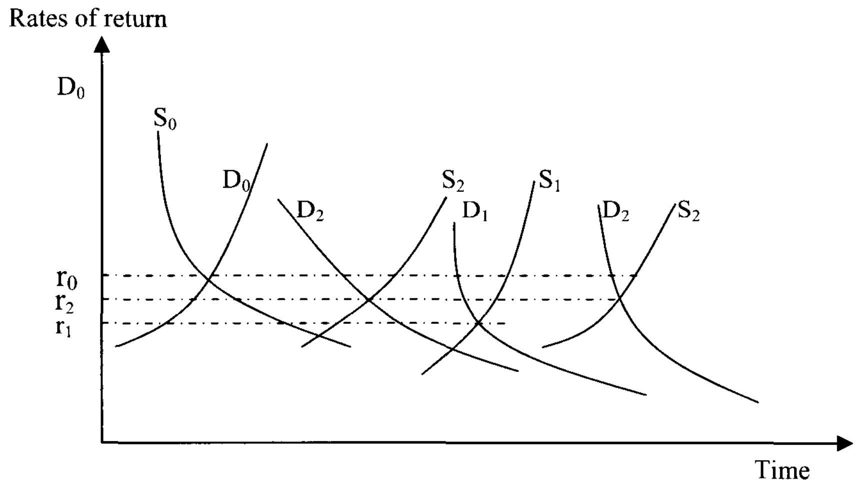
However the signaling value of education is not explored in this thesis. The only measure that I can use of 'whether people are productive and economically valuable is their wages' (Wolf 2002, p.24) and I acknowledge that wages may not reflect the average contribution of workers. However in the absence of other reliable measures of productivity, I use wages to estimate social returns to education which if used carefully can guide future investments in education in the Republic of Mauritius. This is discussed at length in Chapter 7.

2.1.3 Skilled Biased Technological change (SBTC)

Investment in education, if treated as any other investment is likely to be subject to the law of diminishing marginal returns. However as will be discussed in Section 2.31, Psacharopoulos (1985) concluded that educational expansion does not lead to lower returns. He reported stable returns to education over time. The stable over time behaviour of the returns to education following expansion, is consistent with what

Tinbergen (1975) views as a race between education and technology with rightward shifts of demand and supply curves of education, causing the rate to return to change accordingly. Alternatively this Tinbergen (1975) race between education and technology may be interpreted through the skilled-biased technology change (STBC) literature. Either way, both may be used to explain why such a large increase in the supply of educated labour in so many developed and developing countries has not been accompanied by a fall in the mean rate of return across these countries. It is hypothesized that both demand for skilled persons and supply shift in the same direction. The extent to which demand shifts will depend on technological advances, whereas the extent to which supply shifts will depend on educational expansion. This is illustrated in the Figure 2.2:

Figure 2.2: Race between education and technology



The above figure presents the outcome of such a race where at first supply shifts dominate demand shifts and the returns to education fall. But thereafter, the expansion of education is dominated by demand with a rise in returns to education. This is further explored in Sub-section 2.3.2.

2.2 Methodological issues

The OLS techniques generate biased estimates of the returns to education. Some of these biases are briefly listed here and are elaborated in later sub-sections.

- Endogeneity

The schooling measure, S_i is assumed to be exogenous although the Human Capital Theory treats it as being endogenous. Human Capital models of schooling attainment suggest that lower-wage individuals are more likely to invest in education than higher-wage individuals (Grilliches, 1977). Even in reality, those who stand to gain more from education, (those who are more trainable) may invest in more education. Thus, it is argued that high-wage individuals leave school earlier and there is endogeneity bias in the estimate of the return to schooling when the OLS technique is used.

- Omitted variable bias

The disturbance term, u_i captures unobservable individual effects and these individual factors (for example unobserved ability and family background) may affect the decision to invest in education, causing a correlation between schooling and the error term in the earnings function

- Measurement error

Measurement error in the education variables cause OLS estimates to be biased downwards (Angrist & Krueger, 2001; Dearden, 1999).

Given these problems, estimation by the conventional OLS methods will give biased estimates of the return to schooling, r_s. There are a number of ways to deal with these and sub-sections 2.2.1, 2.2.2 and 2.2.3 briefly demonstrate how this may be done.

2.2.1 Omitted variables and ability bias

If the estimation procedure is unable to separate the contribution of unobserved ability to productivity from that made by education, then it will simply ascribe all the additional productivity of more able and better educated individuals compared to those with less education, to extra schooling. Thus, the schooling co-efficient may overstate the contribution of education.

Similarly the education-income relationship may be overstated or understated if some variables that affect schooling are omitted from the model. For instance, if a measure of ability is omitted then the error term will capture it as it is one of the unobserved factors, which also affects schooling. Also as education and ability are positively associated, the OLS parameter, which measures the contribution of education to income, will be biased upward. Ability to do better in education may be correlated with ability to make money in the labour market. There is a complementarity between ability and education so that workers with higher ability (or higher opportunity) will invest more in education (Blackburn & Neumark, 1995). More able people might earn more and this may be translated into higher returns.

An approach to distinguish between impact of education and ability, is to directly include ability measures in a standard OLS model. Here an ability measure such as an IQ test score is introduced as another independent variable affecting wages and the problem of omitted variables bias arises if it is omitted from the equation. So the inclusion of an explicit proxy for ability should reduce the estimated coefficient of schooling (Griliches & Mason, 1972).

However, the problem of ability bias is just one of many problems that arise while estimating returns to schooling. School quality, family background and ability are among the potential omitted variables that have been identified and studied. Card & Krueger (1992) for instance, report that those who grew up in states with better quality schools acquired more education. They argue that school quality affects educational attainment by lowering the marginal cost schooling and by raising the marginal benefits of schooling and thus, making schooling more attractive to individuals.

2.2.2 Endogeneity and Measurement error issues

As argued by Harmon & Walker (1995) there are a variety of sources of bias associated with the returns estimated by the OLS method. In an equilibrium condition, there is a positive correlation between schooling and its return causing the OLS estimates of the return to schooling to be biased upward. So schooling may be endogenous as a result of the individual's optimal choice (Card, 2000). The endogeneity problem is about the schooling variable, S in the earnings function not being exogenous such that the level of education an individual chooses to undertake is influenced by other characteristics such as ability, motivation and expected returns. Motivation, for instance, may be correlated negatively with ability (Weisbrod, 1972). In other words, people with relatively high ability for their particular educational level may have modest or even relatively low levels of motivation. In fact the evidence on this is unclear as it may be that high ability individuals have higher levels of motivation. Weisbrod (1972) points out that one may wrongly conclude that two variables interact instead of acknowledging the effects of a third factor.

Thus, to deal with the endogeneity issue, a researcher posits the existence of an observable covariate that affects schooling choices but is uncorrelated with (independent of) ability factors. Much attention is focussed on the supply-side features of the education system as a source of potential instruments, for example, the minimum school leaving age, tuition costs or the geographic proximity of schooling (Card, 2000).

In the next sub-section (Sub-section 2.2.3), I introduce the instrumental variable approach and state why IV may be preferred over the conventional OLS technique. This IV approach will be discussed at length in Chapter 6.

2.2.3 Instrumental Variables (IV)

Ordinary Least Squares method provides an estimate of the rate of return to education on average while the IV provides an estimate of the rate of return for a specific group of people whose behaviour can be manipulated by the instrument (Angrist & Krueger, 2001). So OLS estimates are commonly lower than IV estimates. However the size of the extra return depends on the choice of instruments. To compute the returns to schooling both the conventional OLS and instrumental variables can be used as in this study. However the IV approach enables the researcher to tackle the problems of ability bias, endogeneity and measurement errors.

The IV approach is a way of splitting the variance in schooling into an exogenous component and endogenous component. These are done by adding variable(s) into an equation to explain schooling decisions which is(are) not in the wage equation. The two-equation system describing log earnings (y_i) and years of schooling (S_i) may be written as follows:

$$
\begin{aligned}
y_i &= X_i'\delta + \beta S_i + u_i \\
S_i &= Z_i'\alpha + v_i \\
Cov(X_i', Z_i') &\neq 0
\end{aligned}
$$

where estimation of the first equation by OLS will yield an unbiased estimate of β only if schooling s_i is exogenous. X and Z are vectors of observed attributes where E $(X_i,u_i) = E(Z_i,v_i) = 0$. The instruments are variables that are not contained in X, i.e. do not have an independent effect on earnings but are included in the vector Z, i.e. they do have a significant impact on the level of schooling acquired. The IV method relies on the assumption that the instrumental variables are correlated with schooling decisions and not directly with earnings outcomes (Harmon, Oosterbeek & Walker, 2003). The results of IVs can, however, lead to large inconsistencies if there is a relationship between wages and the instruments or there is a weak relationship between the instruments and schooling. For example, Bound et al. (1995) demonstrate this by re-estimating the results from an earlier study of Angrist & Krueger (1991), which uses quarter of birth and compulsory school attendance laws as instruments and finds that those estimates are even more biased than the OLS estimates because the instruments used in that study are weakly correlated with schooling. Generally if the correlation between the instrument and the endogenous explanatory variable is weak, then even a small correlation between the instrument and the error term, produces a larger inconsistency in the IV estimates of the returns to schooling than in the OLS estimate.

2.2.4 Heterogeneity in returns to education

Heterogeneity (allowing for differences in marginal returns across different groups of individuals) may be modelled using interaction terms with education. According to Card (1999; 2001), for instance, high ability individuals may earn very different returns to their education. Griliches (1977) for instance, introduces ability as an explanatory variable into the log-linear earnings function and he argues that the more able individuals may be able to convert education into human capital more efficiently relative to the less able one. An increase in educational investments generates more human capital if inherent ability and schooling complement each other. Heterogeneity in returns will be considered in Section 2.3.4.

2.3 Empirical evidence on rates of return to education

2.3.1 Main trends of returns to education in the Literature

Policy makers are concerned about the returns to education to determine whether or not there has been educational over-expansion or skills shortages. According to Blaug (1967), educational policy-makers need to know when the returns to educational investments fall to a level below which further expansion is not justifiable. They also need to know when the returns increase above the alternative discount rate in order to be in a position to recommend expansion. Here allocative decisions may involve educational investments to be made within education itself (for example, by the level of education: primary, secondary and tertiary or by type of education: general and technical education) or if education is a form of investment, human capital investments should be compared to investments in physical capital. Such comparisons may serve as ex ante signals to guide resource planning.

Psacharopoulos (1980) makes comparisons of average returns to physical and human capital across countries in the 1970's and for developing countries he reports larger returns to higher education (14.9%) in developing countries than to physical capital (12.8%) while the pattern is slightly reversed for developed countries with returns on investment in physical capital (10.5%) being marginally higher than returns on higher education (9.3%). He attributes this difference to the relative scarcity of human capital in developing countries and the relatively higher ratio of human to physical capital in developed countries. However given that there is just over one percentage point difference between the two investments, he concludes that both kinds of investments (as theory predicts) in developed countries have nearly reached the point of near equalisation of returns at the margin. In an updated study, Psacharopoulos (1985) compares the trend in investing in both kinds of capital over two time periods, the 1960's and the 1970's. He confirms that a narrow gap exists between the returns to physical and human investment and this convergence suggests an equilibrium of 10% returns to both types of investments.

There is a declining pattern across country type, that is, private returns to education undifferentiated by level fall, as a country moves from a less developed economic status to an advanced status (Psacharopoulos, 1985). His analysis is based on the regression co-efficients on years of schooling in semi-log (Mincer-type) earnings functions, where he uses years of schooling, years of experience and years of experience squared as explanatory variables. The estimates cover a total of 61 countries.

In a recent study, Psacharopoulos & Patrinos (2002) reviews and presents the latest estimates and patterns, reaffirming the importance of Human Capital Theory. He presents estimates of raw returns to education for a maximum of 98 countries. The mean rate of return is based on the Mincer-Becker-Chiswick regression where the coefficient on years of schooling is estimated both by level of education and by level of economic development. He reports that low-income countries with only 7.6 years of schooling on average have the highest returns to education (10.9%)

followed by the middle-income countries (10.7%) such as Europe, Middle East and North Africa with an average of 8.2 years of schooling while the high-income countries have a coefficient of only 7.4% given that they have the highest number of years of schooling on average (9.4 years). It must be pointed out that the returns to education for the high income group such as the OECD countries are considerably below the world average of 9.7% and its years of schooling exceed the world average of 8.3. So the pattern of declining returns to education by years of schooling and level of economic development is confirmed. He also reports that during the last 12 years as average schooling levels have increased, average returns to schooling have declined by 0.6 percentage points implying that an increase in supply has led to a slight decrease in returns to schooling. In other words if education is treated as any other investment, then educational expansion will be subject to the law of diminishing returns. Moreover private returns to higher education continue to remain higher relative to social returns across all countries irrespective of level of economic development (Psacharopoulos & Patrinos, 2002: Table 2).

A brief summary of the findings of Psacharopoulos (1973; 1980; 1985) reveal that returns to education for all levels of education generally exceed the aggregate social opportunity cost of capital. According to him, rates of return in developing countries, especially in Africa are higher than in the advanced market economies. However Bennell (1994) criticises the quality and relevance of the rates of return estimates and also the reporting and aggregation of these estimates by Psacharopoulos. Bennell (1994) reports that social returns to all levels of education in sub-Saharan Africa have fallen significantly during the last two decades and in many of those countries, social returns may be below the aggregate social opportunity cost of capital. He points out that private and social returns are highest for upper secondary education followed by primary education, whereas private returns for higher education continue to exceed the social returns. This is so despite the fact this gap has been narrowing due to rapidly declining employment opportunities for graduates and acute funding crises in African universities.

Bennell (1994) states that the findings of Psacharopoulos may be questioned on several grounds, for instance, there are biases in country coverage. Francophone & Lusophone SSA countries are seriously under-represented, while demographically small countries are over-represented. Only 11 of the 18 country studies cited by Psacharopoulos have both private and social rates of return estimates for all the three levels of education (primary, secondary and tertiary) whereas a complete set of only private returns by level of education is available for Cote D'Ivoire. For other countries such as Burkina Faso & Sierra Leone, studies have complete sets of social returns only. Further, Bennell dismisses the criteria upon which Psacharopoulos chose the estimates. He states that many of the studies, even though a particular author or journal referee or PhD thesis committee felt that the quality of the work was suitable for publication, are of poor quality and the estimates yielded cannot be relied upon. He discusses the considerable impact that omitted variables are likely to have on the estimates of returns to education. For example, five studies (Ghana, Liberia, Western Nigeria, Uganda and Zimbabwe) make only a few adjustments for drop-outs, examination failures and unemployment whereas further two studies (Ethopia and Sudan) rely on crude and unsubstantiated alpha coefficients to account for all other independent effects on individual incomes. The alpha coefficient represents the proportion of earnings differentials resulting from education alone (Hinchliffe 1987). Moreover only the regressions for Kenya and Tanzania have separate variables for innate ability and socio-economic background. Omission of these factors can seriously bias the estimates to returns to education and seriously undermine the comparability of returns across countries. Hence Bennell strongly rejects the results reported by Psacharopoulos.

However Psacharopoulos (1996) clearly points out that the studies he has included in his analysis (Psacharopoulos, 1973; 1980; 1985) differ enormously in terms of data quality, coverage and methodology. But as he argues, for example, a household survey for 1970 in an African country cannot be reconstructed to account for all the suggestions made by Bennell (1994). Moreover there is no other way of assessing whether the primary, secondary or tertiary level should receive priority in the allocation of public funds to education in a particular country, other than using existing estimates yielded from these existing studies if all studies in this area of research are based on representative samples of the population. He also argues that the studies he chose obey some ground rules of methodology. Hence I will continue to relate to Psacharopoulos's work.

Psacharopoulos (1985) analyses the rate of returns estimates over time within countries although he acknowledges that the sampling framework and methodology may differ from one year to the next. His deductions are based on evidence, which clearly indicates that rates of returns have so far remained unchanged even though it was preceded by increases in educational investments. He chooses some countries where the highest quality time series data exists: the US, Japan, Great Britain and Colombia. He points out that there is a remarkable stability of returns over a 30-year period for the US where the social returns, for example, fluctuated around 10% to 11% between 1939 and 1969. In Japan however the returns fell from 6.4% to 5.7% over a 7-year period while in Great Britain, the returns remained constant between 1971 and 1978. Even though the percentage of workers with higher education more than doubled between 1973 to 1978, the returns to education in Colombia fell from only 17.6% to 14.4%.

He therefore concludes that the fears of educational expansion leading to unemployed graduates or to lower social rates were unfounded.

Also the difference between the private and social returns can act as policy indicators. The Mincerian equation is used to estimate social returns whereby the rate of return is based on total costs (private and public) and private benefits. While computing the social return to education, private returns were adjusted for public subsidisation of primary, secondary and tertiary education. In most cases private returns consistently outweighs social returns. This will not discourage them from investing in any level of education unless there are market imperfections. The state may transfer part of the educational expenditure onto the students or their parents (Psacharopoulos & Patrinos, 2002; Sakellariou, 2003). Here estimates of private and social returns to education and the gap between them act as signals to policy-makers as to where to invest more (when social returns exceed private returns) and where to reduce public subsidisation of education (when social returns is much lower private returns). With less subsidisation, higher education will still be attractive given the high private returns. This policy may be inequitable, as students from poor families will not have access to higher education unless there are alternative measures to finance their education, for example the existence of student loans. It is important to consider the discount rate of the educational investment. But as discussed earlier, rates of return studies are restrictive in the sense that the analysis may be plagued by lack of relevant data.

Moreover Psacharopoulos (1994) concludes that both private and social returns to academic education exceed those of technical education because of the high unit cost associated with the latter. Bennell (1996) argues that this finding may not be reliable because Psacharopoulos simply lumps together data from other studies and the methodologies used across those studies may not be homogenous. So after looking for the studies, which use similar methodologies, he combines data for Latin America & Caribbean countries from Psacharopoulos & Ng (1994) and Psacharopoulos (1994) and concludes that social returns to academic education are roughly the same as those to vocational education while private returns to vocational qualification remains higher. Despite the recalculation of private and social returns to education the findings of Bennell (1996) remain unconvincing because he fails to address the possibility of individuals having a mix of academic and vocational qualifications and the resulting different returns to each combination.

Psacharopoulos (1989) investigates the rates of return to educational expansion over time by using the same methodology which is the Mincerian semi-logarithmic earnings function with the same three explanatory variables: years of schooling, years of experience, and experience-squared. The returns for the countries reported in his study, are estimated from data sets based on each country's population census. Out of the nine pairs of end-year estimates, seven declines are reported in the returns to education as the years of schooling increases. The country that records an increase in return is Chile but this is less than one percentage point and may be due to sample variability or particular labour market conditions prevailing in one of the two years (1974 and 1980).

Moreover Dearden et al (2002) concluded that different routes through the education system may yield different returns for some qualifications such as for individuals who completed their 'O' levels and subsequently acquired vocational qualifications. These received the highest return to their investment in education, whereas those who went on to do their 'A' level and a degree received a lower rate of return. The rationale as they argue, is that although 'O' level or the CSE remain significant, they become less relevant in determining future earnings for graduates than for an individual who acquires vocational qualifications after gaining this lower level of academic qualification. The results are consistent across both males and females with the estimated significant co-efficient of 0.248 and 0.285 respectively and these wage premiums are more than twice as large than those who continued the academic route. It should be noted that Dearden et al (2002) have also used interaction variables to study whether wage premiums to a particular level of education remain the same whatever the additional years of schooling the individuals undertake. For example, the wage premium to an A-level may vary according to whether or not individuals eventually study for a degree. It is important to check whether or not such assumptions are valid by allocating the same wage premium to all individuals who completed those years of study. However when including interaction terms, we need to have a larger sample in order to avoid the problem of small cell sizes for these terms.

2.3.2 Findings from Studies that Support the Skilled Biased Technological change (SBTC)

Stable returns to education over time may be explained through the skilled-biased technology change literature, and this was discussed in Section 2.1.3. In this section, I will provide empirical evidence to support this SBTC theory. The large wage inequality in the UK during the 1980's and 1990's, for instance, may be explained as the increase in the demand for skilled labour outstripping the increase in supply. Also, despite the increase in the relative cost of skilled labour in the majority of U.S. industries, more skilled labour is being employed (Berman & Machin, 2000). There is widespread evidence of skill-biased technological change, that is, technological changes raise the demand for skilled labour[6] (in the UK, US and other OECD countries). Technological change occurred not only within industries but also across different countries especially in

[6] For example, Machin 1996 for the UK.

more technologically intensive countries[7] where more is spent on R&D. Also it may be argued that the demand for new skills will continue to rise as long as there is technological change. However, long-run increases in the demand for skills may not be accompanied by corresponding increases in the supply of skills. In the case of UK, the slower growth in the supply of skills in the 1980's may explain the large rise in wage equalities.

I focus on two key studies where the authors argue that there has been skilled biased technological change. The first study is conducted by Machin & Reenen (1998) and the second one is by Berman & Machin (2000). Both deal with shifts in demand for labour in favour of skilled labour.

Evidence on educational expansion being associated with rightwards shifts of the demand for educated labour can be discussed in light of the findings of Machin & Van Reenen (1998). The evidence generated from their study shows that skill-biased technical change is an international phenomenon, which increases the relative demand for skilled workers. They use data on value added and investment from an industry-level panel data set compiled by the OECD known as STAN[8] and a complementary database for R&D data known as ANBERD[9] and the Bilateral Trade Database for international trade information. They look at seven different

[7] For arguments in favour of technology driven change Machin (2001)
[8] STAN stands for Standardised Analytical database
[9] ANBERD stands for Business Enterprise R&D database

countries (the US, UK, Denmark, Japan, Sweden, France & Germany) with 16 industries making up the entire manufacturing sector in each country.

Some descriptive statistics of the key variables for the manufacturing sectors of these countries between 1973 and 1989 reveal that non-production worker share of the total wage bill has risen in all countries in absolute terms with the largest increase recorded for the US and the UK. Also wage differentials between the non-production and production workers, increased very rapidly in those two countries in the 1980s. Certain skill-biased technological changes favour the wage and employment prospects of relatively skilled workers while damaging the wages and employment of the less skilled (Bound & Johnson, 1992; Johnson, 1997). Machin & Van Reenen (1998) conclude that more highly educated workers have increased their relative employment shares and there are considerable shifts in skill structure favouring more-skilled workers. Faster skill upgrading is concentrated in similar industries across countries suggesting that skill-biased technological change has a strong effect in shifting relative labour demand in favour of skilled workers in different countries. However they also point out that when cross-country correlations in industrial R&D intensity are considered[10], all pairwise correlations are positive, large in magnitude and significant. Hence, faster

[10] Here only 15 industries are considered in each country due to the unreliability of the R&D data for the transport goods industry

skill upgrading is observed in similar industries across countries, but the R&D correlations are stronger than the skill upgrading correlations, implying that there are other factors in addition to technology that contributed to the declining labour market position of unskilled workers.

Nevertheless Machin & Van Reenen (1998) argue that there is sufficient evidence of a positive association between new technology and changes in skilled wage-bill shares in all the five countries considered. Other factors in addition to technology, which may contribute to the declining labour market position of unskilled workers, may simply be the ability of institutions to set wages or reduce the power of firms to lay off unskilled workers. The authors argue that R&D pushes up the demand for skills and R&D intensity was higher in these seven countries in the 1980's rather than in the 1970's. Their results uphold the skill-biased technological change hypothesis: there is evidence of a positive association between new technology and changes in skilled wage bill shares in Denmark, Japan, Sweden, U.K. and the U.S.A. Also, they report that the coefficient on the spillover variable for the UK and US was small and insignificant while it was positive and statistically significant with the coefficient on own R&D being insignificant. This suggests that spill-overs such as technological transfer and stimulated physical investment are more important in the smaller Scandinavian economies and Japan but not in the US and the UK.

The second study was conducted by Berman & Machin (2000). They used a global sample of manufacturing industries to investigate skill-biased technological change in developing countries. They report a significant increase in demand for skilled workers in the 1980's in middle-income countries and this is mostly due to skill upgrading within industries rather than to reallocations of employment from low to high-skill industries. The authors argue that this cannot be explained by capital-skill complementarity and hence skill-biased technological change is the most appropriate explanation for this phenomenon. They also show that industries, which substituted toward skilled labour in middle-income countries in 1980's, had already started this trend in the U.S. through the 1960's and 1970's. They relate this demand shift to skill biased technological change because cross-country correlations of shifting skill demand are positively correlated. Also there is evidence of skill-biased technological transfer from the OCED to developing countries.

Berman & Machin (2000) argue that SBTC has been present in U.S manufacturing industries since the late 1950's and it may be viewed in terms of the historical skill-premium which decreased as the supply of educated workers outstripped demand in the 1970's and increased when supply did not keep pace with demand. The authors use data compiled by the United Nations on employment, wages and production for manufacturing industries of several countries. The sample of countries is split into three income groups in 1980: a high income group with GDP per capita exceeding US$10,000, a middle income group with GDP per capita between $2000 and $10,000, and a low income group with GDP per capita below $2000. They report that there is strong evidence of shifts in demand toward skilled labour in middle and high-income countries in the 1980's but these are weak in low-income countries. The increased demand for skill is mainly a within-industry phenomenon, consistent with the SBTC hypothesis. For 11 out of the 12 countries in the high-income group, for example in Japan, Germany, the UK and the US, the wage bill shares of non-production increased, with upgrading occurring in all of them. In 16 out of the 18 countries classified as middle-income group, the shift occurred within industries. However this within-industry demand shift is weak in the low-income countries. They report that all of the 28 sub industries within UK manufacturing shifted towards skills in the 1980s and these ranged from low to high skill industries. These shifts occurred simultaneously with skill upgrading.

Skill upgrading is present even across countries, for example, the correlation between the US and Turkey, a country at the low end of the middle-income group is 0.42 and it is significant at the conventional 5% significance level. Skill upgrading in the US is a good predictor of skill upgrading in middle-income countries. These countries have positive correlations with the US pattern of SBTC in the 1980s.

Moreover Machin & Van Reenen (1998) argue that in most countries, capital-skill complementarity cannot explain the demand shifts toward skilled labour as capital output ratios are increasing fast enough. While capital complements skilled labour more than unskilled labour does, the effect is too small to explain the rise in demand for skilled workers within industries. For instance, in order to explain the increases in 1980s wage bill shares of 4.5 and 4.2 percentage points in the middle and high-income countries respectively, the capital/output ratios ought to be more than double.

However Machin & Van Reenen (1998) base their entire analysis on the assumption that the elasticity of substitution between skilled and unskilled labour is unity. Thus their calculations are only approximations of the true degree of demand shifts. Nevertheless they argue that conceptually these increases in wage bills for non-production workers are cases for the SBTC hypothesis and unlike the study conducted by Machin & Van Reenen (1998) do not rely on indicators such as R&D spending and patents which are absent outside the OECD.

2.3.3 Dealing with ability bias

A seminal study by Griliches & Mason (1972) addresses the specific problem of how the ability measure may be included in estimation of returns to education so that the estimates of the coefficient of schooling are not biased upwards.

The study conducted by Griliches & Mason (1972) takes into account biases that arise due to the omission of ability and quality of education, and report that the schooling coefficient is overstated in the absence of ability measures and school quality measures. They use a sample of 3000 veterans and they supplement the 1964 Current Population Survey (CPS) data with individual military records in the U.S. However they draw their conclusions on only 1454 men who were aged between 21 to 34 and who were working full-time at the time of the survey. These men provided complete information on their occupation, income, family background and their AFQT scores were available. AFQT stands for the Armed Forces Qualification Test and it is used as an ability measure instead of the standard civilian mental ability, IQ test. The authors use semi-logarithmic functional forms and the logarithm of income is their main dependent variable. They measure the impact of an additional increment of schooling (SI) after military service and hence after the measurement of AFQT on the grounds that the bias arising due to the correlation of ability with the omitted quality variable, will be solved and SI is uncorrelated with their measure of ability. Their measure of ability is therefore prior to entering service and hence prior to SI. They argue that using this measure of schooling increment after military service is important because the quality of initial schooling is more likely to be correlated with ability since there is some correlation between socio-economic status and ability. Additionally, because more able students are more likely to get into better schools, performance on intelligence tests at the age 18 partly reflects differences in both the quantity and quality of education. The increment in schooling variable is obtained by subtracting the number of years of schooling completed before military service from the total number of years of schooling completed.

The extent of the ability bias is assessed by comparing the schooling co-efficient in equations whereby the log of income is regressed on education excluding any ability measures, log of income is regressed on education and ability, log of income is regressed on personal background factors (such as father's schooling and occupation and region where the individual grew up) and lastly log of income on education, ability and personal background factors. The baseline equation controls for the individual's colour (COL), age and time spent in military service (AMS). Logarithm of income (LINC) is regressed on the following variables:

$$LINC_i = \alpha_i + \beta_{1i} SB + \beta_{2i} SI + \delta_i Col + \lambda_i AGE + \gamma_i AMS + e_i \qquad (1)$$

Where α is a constant and parameters β_1 and β_2 measures the schooling coefficients before military service and after military service, respectively. δ and λ estimate the impact of colour and age, respectively on the individual's income. Griliches & Mason (1972) even control for the individual's age, as a proxy indicator of the individual's work experience. The other three relevant equations may be rewritten as follows:

$$LINC_i = \alpha_i + \beta_{1i} SB + \beta_{2i} SI + \underline{\beta_{3i} AFQT} + \delta_i Col + \lambda_i AGE + \gamma_i AMS + e_i \quad (2)$$

$$LINC_i = \alpha_i + \beta_{1i} SB + \beta_{2i} SI + \underline{\beta_{4i} PBF} + \delta_i Col + \lambda_i AGE + \gamma_i AMS + e_i \quad (3)$$

and eventually equation (4) is similar to:

$$LINC_i = \alpha_i + \beta_{1i} SB + \beta_{2i} SI + \underline{\beta_{3i} AFQT} + \underline{\beta_{4i} PBF} + \delta_i Col + \lambda_i AGE + \gamma_i AMS + e_i$$

Here β_3 and β_4 measure the effects of ability (AFQT) and personal background factors (PBF) on income. The proportionate bias in the schooling coefficients that arises due to the omission of a relevant factor is then derived by subtracting the ratio of the schooling coefficient after the inclusion of the relevant factor to that before the inclusion, from 1 or simply[11] $\left(1 - \dfrac{\beta_x}{\beta_y}\right)$. The drop in the SB (grades of school completed before military service) coefficient is greater than in the SI coefficient

[11] where β_x and β_y are the schooling coefficient after the inclusion of the relevant factor and the schooling coefficient before the inclusion of the relevant factor.

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when ability or personal background factors are included. The decline in the SB coefficient is almost three times greater than that in the SI coefficient. Education before military service, SB is highly correlated with ability and personal background factors and biased downward. Griliches & Mason (1972) attributes this to the absence of a measure of school quality. However the difference between the two schooling measures are not significant at the conventional 5% level implying that the effects of SB and SI are similar on income.

The same approach of comparing the baseline model with other equations as ability and personal background measures are included gradually, is adopted to estimate the effect of total number of years of schooling (ST) on income. The base line equation is similar to:

$$LINC_i = \alpha_i + \underline{\underline{\beta_{0i} ST}} + \delta_i Col + \lambda_i AGE + \gamma_i AMS + e_i .$$

Here a decline of 28% in the total schooling co-efficient is estimated with 11-15 percent attributed to the inclusion of the ability measure, AFQT and the rest attributed to personal background factors, PBF. The authors state that PBF relates to the omitted school-quality dimension. Their results confirm that the increment in schooling coefficient is over-estimated by 12% if no measures of ability or school quality are included, but at the same time they argue that this is much lower than the 40% originally suggested by Denison (1962). However Taubman (1972) argues that the sample of veterans is too small to test for interactions and non-linear effects of schooling and ability on the log of wages or to give reliable results. He also points out that the ability variable captures only a particular type of ability and reminds us that the sample of veterans is not representative of the population because it contains extremes of ability and certain SES groups are under-represented. Hence the correlation between the ability measure, AFQT and the omitted school quality variable may be higher for this population of veterans than for the rest of the population, implying that Griliches & Mason (1972) overstate the ability bias in the education coefficient. Nevertheless their study points out that omitted variables do indeed bias the estimate of the schooling coefficient. This is an issue that we need to be aware of in this PhD as the data used do not contain measures of IQ.

2.3.4 Endogeneity and measurement errors issues

I intend to analyse three studies that include instrumental variables in an attempt to understand how similar instruments may be applied in different contexts. I report all their subsequent findings. The first study is conducted by Harmon & Walker (1995), the second by Pons & Gonzalo (2002) and the third by Dearden (1999). It should be noted that the first two studies deal with only male workers in their samples 'so that complications associated with the disrupted work careers of women because of childbirth and rearing are avoided' (Pons & Gonzalo, p. 749). I refer to only a part of Dearden's (1999) study to discuss the problem of measurement error.

Harmon & Walker (1995) estimate the economic return to schooling for the UK using IV and a selectivity model addressing the endogeneity of schooling. Their results suggest the presence of a large and downward bias in the OLS estimates of the schooling-earnings relationship. To address the problem of endogeneity they use the change in the minimum school leaving age as an instrument. The change in the law caused a change in the amount of schooling acquired by those individuals who were affected by the law, but this did not have any direct impact on wages. The data sets they use were nine consecutive annual UK Family Expenditure Surveys (FES) from 1978 to1986 and their sample consists of 34,336 employed males in the age group 18-64. The minimum school-leaving age (SLA) legislation was first introduced in 1947 causing the minimum age to rise from 14 to 15 years and then in 1973, the minimum SLA was raised from 15 to 16 years. Figure 2 provides the schooling broken down by minimum school-leaving age:

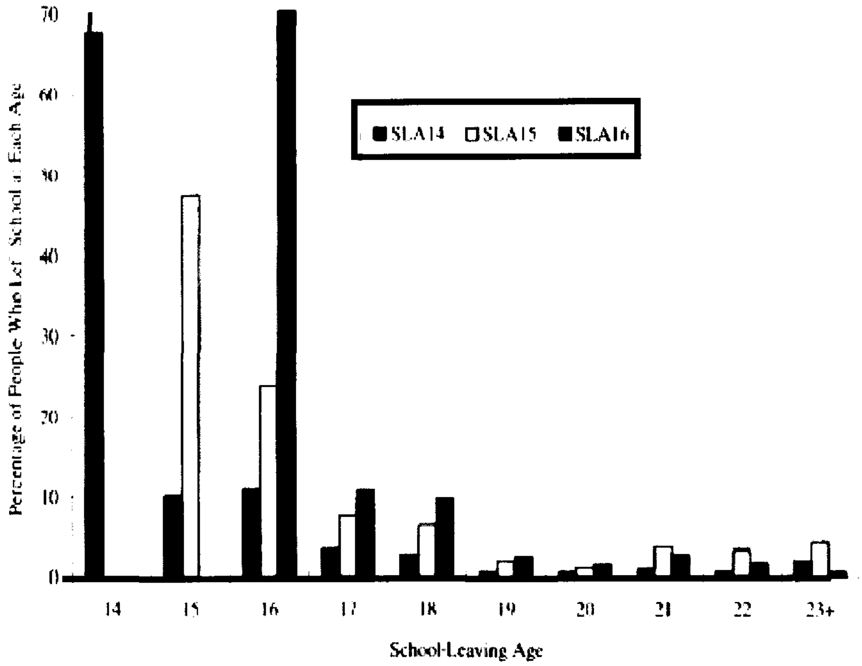


Figure 2.3: Schooling distribution for the United Kingdom

Source: Harmon & Walker (1995) p. 1280

As the figure clearly shows the 1947 legislation raised participation in post-compulsory education, that is, many of those who would have left schools at age 14 stayed on beyond the age of 15. However when Harmon & Walker (1995) compared the age-specific cohorts who faced a minimum SLA of 14 with the same age cohorts but who faced a minimum SLA of 15, using the relationship between log-earnings residuals and schooling, they found that the two cohorts had an expected wage differential of only 3% at school-leaving age 15 and this is statistically insignificant. Even the regression of log earnings including the variables: years of schooling, age, year and a dummy for the change in the minimum SLA reveals that the estimates of the coefficient on the dummy variable are not significant. These results suggest that the minimum SLA instrument generates insignificant estimates. They pursue an extension of the Heckman two-step approach. Their dummies record the exogenous change in the minimum school-leaving age on years of schooling. OLS yields an estimated return of over 6% which is consistent with the returns obtained by other studies for the UK (Machin et al 1993; Moghadam, 1990). The estimates generated by the IVs method suggest that these OLS estimates are much smaller, for example the return to schooling using instrumental variables, is estimated to be more than double or around 15%.

Dearden (1999) points out that the IV procedures may over-estimate the true average marginal return to education. This is true in the case where the instruments used rely on interventions that affect schooling choices of children with low tastes for education. They may earn 'higher average marginal returns to certain education qualifications than the population as a whole' (Dearden, 1999: 32). She thus attributes the higher returns reported by Harmon et al (1995) to heterogeneous[12] returns to education for those leaving school at the minimum school leaving age. Besides, Card (1999) argues that returns to schooling are heterogeneous. This occurs especially in the case of those whose schooling choices are affected

[12] Heterogeneity in the returns to education is further discussed in a later section. It is about individuals responding to education differently. Returns differ across individuals because they differ in the efficiency, with which they exploit a given level of education to raise their individual productivity (Blundell et al, 1998).

by interventions such as the minimum school leaving age and who come from relatively disadvantaged family backgrounds with high discount rates. The IV parameter is known as the Local Average Treatment Effect (LATE) estimates. He also states that IV studies provide inconsistent estimates of the average return for the population as a whole as the marginal returns of the above will, in most cases, exceed the average return for the population.

The second study that I intend to look at is the one conducted by Pons & Gonzalo (2002). They estimate the returns to schooling in Spain using OLS and IV and conclude that OLS not only give inaccurate estimates for the coefficient of β but this estimate is biased downward. They use two Spanish data sets: the Survey of Structure, Conscience and Biography of Class (ECBC) for 1991 and the Household Panel of the European Union (PHOGUE) for 1994. The results they obtained from the traditional Mincerian wage function using OLS, however yield returns to schooling that are equal to 6.4 % in ECBC and 5.8% in PHOGUE that the authors claim to be similar to the results reported by the majority studies for the Spanish case. They then proceed to use the IV method. The instruments they use are slightly different from those used by Harmon & Walker (1995).Each data set has its own advantages, for example, with ECBC it is possible to build a measure of college availability in the province and also to build dummy variables based on an individual's age to reflect the change in minimum school-leaving age (MSLA) while PHOGUE also provide information on an individual's season of birth.

But using the data set PHOGUE, Pons & Gonzalo (2002) cannot use natural experiments such as the rise in the minimum school leaving age[13] or the season of birth because these variables need to be sufficiently correlated with the years of schooling before they may be used to estimate the returns to schooling. If this is not the case, the weak correlation between the potential instruments and the wage can result in a large bias in the IV estimates and thus, yield more inconsistent estimates than those obtained using OLS (Bound et al, 1995).

Both the MSLA and the season of birth are weakly correlated with the years of schooling in the Spanish case. As a result of the weak correlation, Pons & Gonzalo (2002) observe an increase in the standard error of the estimated co-efficient of schooling that is not significant, even though the season of birth has a positive effect on schooling attainment. F-tests on the excluded variables were performed to test the correlation between the instruments and the years of schooling and the inclusion of an identifying variable must improve the R^2. The quality test showed that the correlation between these instruments and the years of schooling is not strong enough to accurately estimate the returns to schooling.

[13] The MSLA legislation in Spain was introduced in 1970

Another instrument that Pons & Gonzalo (2002) use is a data set of family backgrounds such as parent education, father's occupation, father's sector, father's responsibility and father's contract. The regression results for the reduced form of the schooling equation using these sets of instruments reveal that men with less educated parents have on average significantly fewer years of schooling while those having a self-employed father with a high level of responsibility in a job, with a permanent contract, employed in a white collar job or working in a non-agricultural sector, have more years of schooling.

Another set of instruments that Pons & Gonzalo (2002) use is college availability. Male workers who grew up in an area with no school would have incurred high schooling costs and this might have acted as a disincentive to stay on at school. They adopt Card's (1993) suggestion that a college availability effect might have different consequences depending on family income, for example, having a college nearby has a greater effect for low income families and hence they include a dummy which takes the value of 1 if the father is a manual worker. They also adjust for labour market demand. If there is high graduate unemployment, this reduces the demand for education and hence they not only account for the unemployment rate when the individual was at the age of 16 but they also consider the Spanish region where the individual lived at 16. They take into account interactions between the local labour market effect and college availability. The variable unemployment at 16 that captures the local market effect on demand for education is negative and significant at the 5% level and the income of poor families does affect the college education inversely.

Also Pons & Gonzalo (2002) state that they do not expect a consistency problem as their sample size is sufficiently large. Consistency means that the estimator converges to the population parameter as the sample size grows and unbiasedness refers to the estimator having a sampling distribution centred on the parameter of interest in a sample of any size (Angrist & Krueger, 2001). As instrumental variables are consistent but not unbiased,[14] while using instruments researchers must work with large samples.

Davidson & McKinnon (1993) also point out that the problem of the finite-sample bias becomes worse as the number of instruments used within small samples increase. According to them there are two conflicting objectives associated with small samples: as the number of instruments increases the estimates of the returns may become more efficient asymptotically but at the same time, the results may suffer from

[14] IVs estimates involve a ratio of random quantities and they may not have a simple form.

the finite-sample bias. Also, when the instruments are weakly correlated with the endogenous variables in the model, the parameters are not strongly identified. However, as has been said already, Pons & Gonzalo (2002) argue that their results do not suffer from finite-sample bias, given their sufficiently large sample size. Once they use the interaction between low-income variable and college availability as an instrument, the estimate of the returns to schooling becomes more efficient. When parents' education and college availability are considered jointly, the estimate of return to schooling is more efficient than when using college availability instruments only. They obtain a return to schooling of 10.5%, which is higher than the 6.4% derived from OLS. Other studies also confirm that IV estimates of the returns to education based on family background are higher than classic OLS estimates (Psacharapoulos & Patrinos, 2002; Card 2001).

Also instead of using the inverse of Mill's ratio[15] (λ) in their selectivity model as Harmon & Walker (1995) to test the assumption that schooling may be endogenous, Pons & Gonzalo (2002) use the Hausman t-test on exogeneity. This test is implemented by including the residual obtained from the regression of schooling on the instruments as a regressor in the

[15] The problem of selectivity bias arises because the wage equation is estimated for a non-random sample of individuals and these individuals are at work. It is argued that the characteristics of those who are at work and those who are unemployed differ. The Mill's ratio is used to test the hypothesis of no selection bias. This is discussed later in Chapter 5.

original wage equation. The test allows them to reject the null hypothesis that the OLS estimate is consistent (H_0: $\beta_{OLS} = \beta_{IV}$) with a negative estimate significant at 1% level. So both the conventional IV and the selection model provide evidence that OLS estimates are indeed biased downward.

Nevertheless as discussed by Card (2000), even the IV estimation based on ideal instruments, will only give a weighted average of returns to education for people whose education choices were affected by those instruments, rather than the average marginal return to education in the population. In other words the effect is estimated for those who are affected by the instrument or 'treatment'. Hence the IV parameter is called the Local Average Treatment Effect (LATE). If all subjects in the population have the same response to a particular intervention, then the experiences of the group of 'compliers' captured by LATE represent those of the entire treated group. Hence there is no distinction between LATE and other parameters. However if responses within the treatment group differ, the parameters estimated by IVs will differ from the average effect of interest. Here the 'heterogeneous treatment effects' applies (Angrist & Krueger, 2001).

A related methodological problem with OLS is that, in the case of measurement error, the bias in the OLS estimate is downward. The IV method can also address the problem of measurement error. The Instrumental Variable method can be used if the instrument is correlated with the true measure of education (schooling) but uncorrelated with the measurement error in schooling. Measurement error arises because of many reasons such as the limited ability of statistical agencies to collect accurate information, and recall bias (individuals forgetting things that happen a long time ago), and the variables collected in practice do not always match those specified in economic theory. If an explanatory variable is measured with additive random errors, the coefficient in a bivariate ordinary least squares regression will be biased toward zero in a large sample and the greater the proportion of variability (due to errors), the greater the bias (Angrist & Krueger, 2001). However IVs can provide a consistent estimate even in the presence of measurement error. This is true if the instrument is uncorrelated with the measurement error and the schooling equation error term but correlated with the correctly measured variable.

Dearden (1999) controls for measurement error in her estimation of returns to schooling. She uses the National Child Development Study (NCDS) data set for 1981 and 1991 and looks at qualifications obtained by the individuals. She acknowledges that qualifications may be measured with error in which case her estimates of the returns to school and post-school qualifications will be biased downward. She however uses the IV method and finds at least one instrument, which is correlated with the true measure of her qualification variables but uncorrelated with the measurement error. However she only corrects for possible measurement error associated with each individual's highest school and post-school qualification.

Given that the qualification measures are discrete, Dearden (1999) first estimates two reduced form ordered probits for the school and post-school variables. Then she uses the estimates obtained to calculate the Heckman selection adjustment term for her two qualification variables. To check the robustness of this procedure, she estimates a standard IV model using the linear probability models for all the qualification variables she had earlier, rather than just the two school and post-school variables. She reports evidence of biases associated with measurement error when she carries out the traditional IV estimation.

Her results suggest that the longer the time between completing the qualifications and the time of the survey, the more severe the problems of measurement error tend to be (Dearden, 1999). She reports that many of the individuals in her sample have obtained their qualifications at least 10 years earlier. If the measurement errors in the 1991 sample are uncorrelated with the measurement errors in the 1981 variables, then these variables can be used as instruments to correct for possible measurement error. When she does this, she reports significant measurement error problems associated with post-school educational qualifications when the standard IV procedure is followed. Finally she concludes that measurement error in the education variables can lead to significant downward biases in OLS estimates of returns to qualifications.

2.3.5 Heterogeneity in returns to education

Returns to schooling may be different for individuals in different parts of the wage distribution. Harmon et al (2000) show that the returns to schooling are different for people in the upper part of the wage distribution as opposed to those in the lower portion of the wage distribution. He uses a different methodology, the quantile regression (QR). Unlike OLS, which only captures the mean effect of education on individuals' wages, QR estimate returns to education within different quantiles of the wage distribution. This method requires education levels to be widely spread across the different parts of the wage distribution so that the returns for each decile can be identified. In other words some individuals in the bottom deciles must have high education and some in the top deciles must have low education.

The FES data for 1980, 1985, 1990 and 1995 satisfy this requirement and the returns are statistically significant for each decile. They report that returns at the top of the wage distribution have risen. Harmon et al (2000) argue that the distribution of inherent ability explains the distribution of wages. Lower ability individuals predominate in the bottom half of the distribution implying that education has a bigger impact on the more able than the less able. They even point out that this complementarity between ability and education has become larger over time. However this may also reduce the internal rate of return if ability to progress in school is positively correlated with the ability to earn. Here the more able has higher opportunity costs as they could have earned more in the labour market. And they argue that the ability measures need to indicate ability to make money rather than ability in an IQ sense.

Harmon et al (2000) use two specialised datasets: the GB National Child Development Study (NCDS), which provides information on individuals born in 1958 about subsequent careers and earnings, and the International Adult Literacy Survey (IALS[16]). Among the equations they estimate, for the NCDS they use the results of Maths and English ability tests first at the age of 7, then at the age of 11 and at the age of 16. They also estimate the same model using the IALS data which gives them ability controls at the current age. Their results confirm that ability control at a later age is contaminated by the effects of schooling and the bias is larger while the results with ability controls at the age of 7 generate the most accurate estimates. Also using the NCDS, they include interaction terms between

[16] The literacy test is measured on three scales: prose, document and quantitative.

ability measures and years of education to allow ability to have a larger effect the longer one stays at school. They conclude that although the effects of ability on wages are significant, education largely enhances productivity. However their results cannot be generalised as these depend on the effectiveness of the ability measures included in their analysis and returns to schooling may vary according to the individual's ability.

Heterogeneity in the returns to education can be tested by using interaction terms. If the returns to education vary by ability level, then interactions between ability measures and schooling may be introduced in the model (Card, 1999). Dearden (1999) uses the National Child Development Study (NCDS) data set and includes control variables for ability and family background effects, and she also investigates bias arising from self-selection into employment. She concludes that the measurement error and the selectivity bias offset ability and family background biases. She uses interactions between ability and family background variables to look at whether or not there is any evidence of heterogeneity in returns to schooling. She uses the NCDS, which contains a lot of information about family background, parents' education, social class, interest in the child's education, financial circumstances and so on. She splits her sample into high and low ability groups to deal with the ability bias. Those in the top two quintiles of either the mathematics or reading ability tests are considered as high ability individuals. She then interacts all her education variables with the high ability dummy variable. But she finds no evidence of heterogeneity in the returns to education according to ability. She also interacts her education variable with three family background variables, one dummy to denote those with financial difficulties, another one to take into account the mother's interest in her child's studies and finally the father's number of years of schooling. She reports no heterogeneity in the returns to education according to family financial circumstances. However she reports that as the father's education increases, returns to education decline. Similarly returns to education are lower for individuals' whose mother showed interest in their studies at a young age.

Following Card (1999; 2001), Koop & Tobias (2004) consider a variety of possible forms of heterogeneity. They allow the marginal costs and marginal returns to education to vary across individuals in the population. The intercepts and slopes in their models vary to reflect heterogeneity in returns at the individual level. They report that the heterogeneity follows a continuous rather than discrete distribution and that bivariate normality best describes heterogeneity in intercepts and returns to schooling at the individual level.

Koop & Tobias (2004) use the rich panel study of the National Longitudinal Survey of Youth (NLSY) consisting of 12,686 individuals within the age range of 14 to 22 in the U.S. who were first interviewed in

1979. They directly control for unobservable effects such as ability and motivation through the individual effects, assuming that these factors do not vary over time. They restrict their sample to white males who are at least 16 years old in a given year, reported as working at least 30 weeks a year and 800 hours per year. They do not however investigate the issue of measurement error on the grounds that they exclude all individuals whose hourly wage is less than \$1 or exceed \$100 dollars and those whose education decreases across time and those for whom the reported change in years of schooling over time is not consistent with the change in time from consecutive interviews. They thus argue that they delete all individuals whose education is misreported from all analyses.

The dependent variable used in their models, is the log hourly wage at the respondents most recent job with other variables being potential labour market experience, its square, local unemployment rate, standardised test score, highest grade completed by each parent, number of siblings and whether or not the respondent lived in a broken home at the age of 14 (Koop & Tobias, 2004). They report that the effect of ability on wages increases as the individual acquires more education and there is a negative effect of family size (number of siblings) at small values of education, for example, below 12 years of schooling but a positive effect at higher values of education. Thus Koop & Tobias (2004) strongly suggest that returns to schooling are heterogeneous.

2.3.6 Vocational and academic education

From a policy perspective, it is important to know the labour value of different types of qualifications, for example we need to know whether vocationally oriented education or academically oriented education yield the highest return in the labour market. Some studies lump together all the different routes that an individual may take in the educational system and many rates of return studies focus on the returns to an additional year of education based on the assumption that returns to all types of qualifications are homogenous. In this section, I focus on evidence available from the UK because the education system of the Republic of Mauritius is very similar to that of the UK. Also given that the data set available for this PhD does not provide information on ability and family background, I compare findings of similar studies to those which account for these variables so as to extrapolate the likely bias OLS generates due to the omission of these variables.

As discussed in Sub-section 2.3.5, empirical evidence suggests that returns are in fact heterogenous, for instance, Robinson (1997) shows that returns to academic qualifications are higher than the returns to vocational qualifications. He uses the highest qualifications acquired by the individual in his regressions, but unlike Dearden (1999) he neither controls for ability nor family background effects. His estimation to returns is based on the assumption that these biases are small which may only be true for vocational qualifications but not for some academic qualifications. Another study conducted by Dearden (1999) with NCDS data set, uses the highest qualification an individual acquired and makes no allowance for the different routes an individual may take within the educational system. Other studies (Psacharapoulos 1994; Dearden et al., 2002) provide sufficient evidence to suggest that returns to education are indeed heterogeneous and hence, one needs to distinguish between different types of qualifications that arise.

Dearden et al (2002) find that once the time invested to acquire each qualification is taken into account, the returns per year of study for vocational qualifications tend to move closer to those for academic qualifications. They use two British data sets - the 1991 sweep of the National Child Development Study (NCDS) and the 1998 Labour Force Survey (LFS) - to estimate returns to academic and vocational qualifications. They compare the different ways of estimating returns from the NCDS and the LFS and conclude that on average the estimates obtained from the data provided by the LFS were similar to those provided by the NCDS. The NCDS yields estimates that control for variables such as ability, family background and measurement error, whereas the LFS data set merely allows control for region, age and gender.

Nevertheless the empirical models derived from the NCDS data yield returns similar to the conventional OLS estimates derived from the LFS data. From a methodological perspective Dearden et al (2002) argue that this LFS data set can be used to generate reliable estimated returns to education. They confirm that estimates that do not control for ability tend to be biased upward, whereas those in the presence of measurement error in the qualification variables, tend to be biased downwards. Thus, the two biases offset each other. The advantage of their approach over any other studies is that they allow for the complexity of routes that individuals take in the real world and they do not simply analyse wages in relation to the highest qualification obtained by an individual. Their wage equations include all the qualifications held by the respondents and thus, the wage effects from taking any given mix of academic and vocational qualifications can be analysed.

2.4 Conclusion

Ideally, for private rates of return to education, the calculation involves the explicit costs of schooling born by the private individual, his/her opportunity cost in the form of foregone labour income, private non-monetary benefits and the expected increase in his/her future net-of-tax labour earnings. The social rate of return to education will take into account the total costs of education, the total increase in production (before tax wages) and external effects generated by an increase in schooling attainment (Fuente, 2003).

However, in reality, calculations of private or social rates of returns to education are specific and restrictive due to lack of data. The objections raised against the use of rates of return analysis have been discussed. These included shortage of data especially in some developing countries, the use of cross-sectional data which do not represent the trend of the individuals' earnings over the course of their working lives, the exclusion of consumption benefits which underestimates the rates of return estimates, wages may not be a good proxy of productivity, individuals may not behave rationally, there is uncertainty, and non-monetary benefits are usually not included in rates of returns analysis.

Thus, the studies discussed in this chapter provide examples of calculations of returns to education that are usually carried out in the real world. The problem is empirical rather than conceptual. Thus, similar to these studies, I can only provide estimates that are approximations to the rates of return to education for the Republic of Mauritius. These will act as gross indicators to inform policy making in the absence of alternative measures.

I now summarise the main empirical trends in the literature. The returns to education depends on a country's economic development, that is, private returns to education undifferentiated by level fall as the country moves from a less developed economic status to an advanced status (Psacharopoulos, 1985). The private and social returns are highest for upper secondary education followed by primary education, whereas private returns for higher education continue to exceed the social returns. According to Psacharopoulos (1985) the big difference between private and social rates of returns can allow governments to reduce their spending on education as with less subsidy higher education will still be attractive given the high private returns.

I intend to investigate whether these hold true for the Republic of Mauritius. However the gap between the private and social returns (due to the degree of subsidy by government at all levels of schooling) cannot be assessed as the micro data to be used does not distinguish between gross and net incomes.

Moreover it is argued that the estimates of returns to education reflect not just the productivity enhancing effect of education, but also the effect of ability on earnings that education signals. At one extreme, education may not be enhance production at all. According to credentialists, education only serves to allocate able people to better paid jobs. Education only acts as a mechanism to rank, screen and select people in a mass society (Wolf, 2002). The signalling value of education in this thesis has been discussed in terms of Spence's (1973) 'Job market signalling' theory.

This might have been partly investigated in this research for the Republic of Mauritius, by for example, comparing the returns to 'sixth form' which is unsuccessful completion of A level with GCSE and successful completion of A level. I can hypothesise that the returns to 'sixth form' will be lower than those for GCSE and 'A' level if it signals to the employer that the individual is relatively 'less' motivated and hence less productive. However it must be pointed out that such a comparison cannot actually be made because the sample size of those whose highest qualification levels are 'sixth form' constitutes of only 24 individuals. Nevertheless, the IV method will be used in Chapter 6 as the main way to tackle both the ability bias and the endogeneity problem.

The endogeneity problem arises when more able individuals choose more education. To tackle this endogeneity issue, as stated previously, the instrumental variable method will be used in this PhD, for estimating social returns to schooling. This requires finding some instrument that affects schooling choices but is uncorrelated with (independent of) ability factors. IVs may be used if the instrument is uncorrelated with measurement error but correlated with schooling. But the estimates of IVs may be inconsistent if there is a weak relationship between the instruments and schooling. Family background instruments especially the parent's education, perform best in the studies reviewed in this chapter and natural experiments variables such as season of birth may not always be sufficiently correlated with the schooling variable causing standard errors to rise. But for the purpose of this PhD, I do not have these data and hence I can neither use family background measures nor season of birth.

Nevertheless I intend to use some other instrument such as the introduction of free secondary education for estimating returns to schooling in the Republic of Mauritius. However IV estimates are not directly comparable to OLS estimates because IV estimates produce only LATE estimates - estimates for individuals who would not have received the treatment otherwise. The IV methods estimate the return to schooling for some specific sub-group. The justification for using IV estimates is that even if such estimates are applicable only to a marginal group, policy decisions are usually aimed at marginal groups. Also we cannot always claim that IV estimates are always higher than OLS estimates because it depends on the instruments used.

In this chapter I discussed the heterogeneity in the returns to schooling and conclude that most studies provide strong evidence that returns of schooling differ for different routes taken within the education system. For instance, the labour value of different types of qualifications at the same level may not be the same. Many of the rates of return studies cited in this thesis conclude that the returns to vocational education may be as high as the returns to academic education, depending on the educational routes taken by the individual. However for this study, data are only available for the highest qualification levels achieved by a particular individual and thus, it is not possible to look at the market value associated with different combinations of qualifications.

It is argued that educational expansion may not lead to a fall in returns to education if it is followed by an increase in demand for education driven in part by technological advances. The two studies, Machin & Van Reenen (1998) and Berman & Machin (2000) illustrates this through the SBTC hypothesis. Machin & Van Reenen (1998) provide evidence to show that skill-biased technical change is an international phenomenon, which increases the relative demand for skilled workers. This hypothesis may also hold true for the Republic of Mauritius as over the recent years there has been an increasing demand for skilled workers due to the setting up of the Information Technology sector 'Cyberspace'.

Berman & Machin (2000) argue that increase in demand for skilled labour cannot be explained through capital-skill complementarity because, although capital complements skilled labour, the effect is too small to explain the rise in demand for skilled workers within industries. Hence skill-biased technological change is the most appropriate explanation for this phenomenon. Faster skill upgrading is concentrated in similar industries across countries and it is a within-industry phenomenon. Stable or higher returns to higher levels of education for the Republic of Mauritius may be interpreted according to the SBTC. For instance, there has been an increase in the supply of education and yet the higher returns in the Republic of Mauritius (as will be presented in chapter 5) imply that the demand for skills exceeds the supply of skills, which is consistent with the SBTC hypothesis. But as the data available to this researcher is only one cross sectional data set, I cannot provide evidence over time to support this SBTC hypothesis.

In Chapter 3 I present the education system of the Republic of Mauritius and I discuss some issues related to efficiency and equity. These concepts will be used in Chapter 7 while discussing the policy implications of the findings, arising from this study of the social returns to schooling and to qualification levels for the Republic of Mauritius. I also refer to two changes in the education law - the 1993 Basic Compulsory Education Act and the free secondary education law implemented in 1977. These are potential instruments to estimate social returns to an additional year of schooling given that OLS may generate inconsistent estimates due to endogeneity bias, ability bias and measurement error in the schooling variable (Levin & Plug, 1999).

Chapter 3: The Education System in the Republic of Mauritius

3.0 Introduction

The Republic of Mauritius is an island group consisting of the island of Mauritius, a smaller island Rodrigues and a group of inhabited outer islets. The Republic has a democratic system of government based on the British pattern and a system of education, which also emerged from the British educational system. The main island, Mauritius is of volcanic origin and its area is about 720 square miles.

Population for the Republic of Mauritius is currently estimated at 1.2 million and its fertility rate is at 2.1%, that is, at replacement level of the existing population. Like other upper middle-income countries, the rate of growth of its population is expected to decline as a result of a projected reduction in fertility. The percentage of primary school children is around 11% of the overall population and is expected to decline to 9.1% by 2010 (World Bank, 2002). Hence the total primary pupil population is expected to fall accordingly. However the annual growth rate for the total secondary student population is estimated at 0.6% and it will decline only after 2010 at an annual rate of 2.1% until 2015 (World Bank, 2002).

In this chapter, I will start by discussing the level of investment in education in Mauritius, that is, both public and household expenditures on education. I use the analysis provided by the data sets: the Continuous Multipurpose Household Survey (CMHS) for 1999 and the Budget Household Survey (BHS) for 1996/1997 for this purpose.

I then move on to present and discuss the structure of the education system (post Education Reform 2003) in the Republic of Mauritius. A brief history about how this system evolved through time is also given. Vocational education is discussed at length and I analyse the evolution of the institution created to co-ordinate training programmes at national level and to maintain international competitiveness. I also include the Technical School Act of 1990 in my discussion.

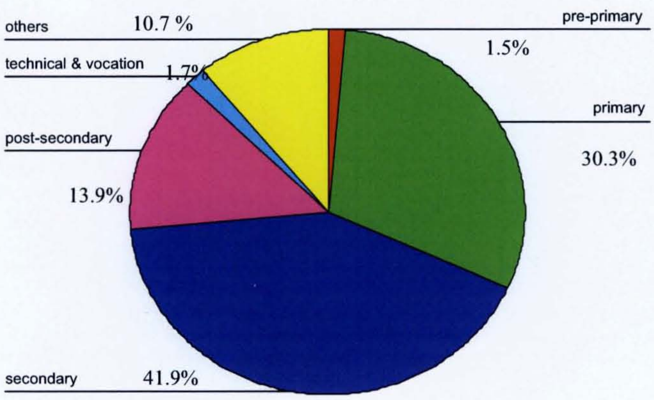
I look at post-secondary education, listing all the major institutions offering such courses in the Republic of Mauritius. A brief comparison is made between the proportions of students studying at home and abroad, and some figures are provided for the periods 2000-03 to support my arguments. Lastly I address the problems of the inefficiency prevailing in the education system through the cycle of primary and secondary schooling and the inequalities prevailing within these cycles.

3.1 Expenditure on education in the Republic of Mauritius

3.1.1 Public spending on education

The fiscal year in Mauritius starts on the 1st of July. There has been a remarkable increase in nominal total public spending on education over the last two years due to the massive capital investments in education. Total recurrent expenditure on education was around Rs 4563 million for the financial year 2003/04. The secondary sector has the major share of the budget allocated to the Ministry of Education, followed by the primary sector (CSO, 2003b). This is illustrated in the Figure 3.1:

Fig 3.1: Proportion of spending by sector for 2003/04



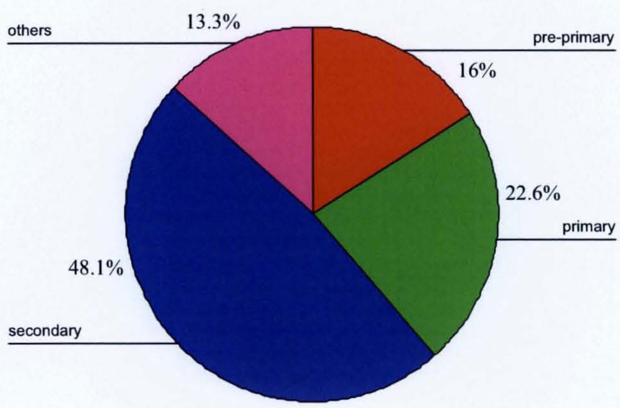
Source: computed from CSO (2003b)

It should be noted that compared to most upper middle-income countries, the Republic of Mauritius spends a lower proportion of its GDP on education (World Bank, 2002). Only 3.3 % of GDP, for instance, was spent on education in the Republic of Mauritius during the year 2001. The government's objective (in Mauritius) is to provide universal access to 11 years of quality education and to extend universal access to higher education. However, these policies will require a larger share of the GDP around 4.9% and 5.4%, respectively (World Bank, 2002). These will cover the recurrent costs associated with providing larger access to tertiary education.

3.1.2 Household expenditure

Usually in Mauritius, a significant proportion of household income is spent on private tutoring. Two surveys were conducted: the Continuous Multipurpose Household Survey (CMHS) in 1999 and the Budget Household Survey (BHS) in 1996/1997. Although the data are not directly comparable, they indicate that there has been an increase in household spending on education of more than 100 percent between 1996 and 1999 which is the latest year for which data is available. Private spending on education in 1996 according to the BHS data amounted to a total of US$ 36.3 million and according to CMHS data, this spending amounted to US$ 81.7 million in 1999 (World Bank, 2002). These figures indicate a 30% rise in private expenditure on education within a very short period and that household contribution to education spending is significant, and is increasing over time. Also data from BHS reveals that private tuition[17] accounted for 61.3% of total private spending on education and 22.6% was spent on textbooks and other requisites while 16% was spent on pre-primary schooling. The distribution of household expenditure between different levels of education is illustrated in Figure 3.2.

Fig 3.2: Total spending on education by Households for 1996/97



Source: CSO (2002d)

Household expenditure accounts for about 33% of total national spending on education which is higher than that of India (2%), Jordan (2%), Malaysia (4%) but lower than that of Madagascar (40%) and Kenya (38%) (World Bank, 2002). Both public and private spending amounted to 6.1%

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[17] Private tuition is pervasive throughout the education system and constitutes an important source of additional income for teachers.

of GDP in 1999. This corresponds to the total expenditure on education for Botswana and Malaysia, that is 8.6 % and 7.9 % respectively (World Bank 2005a, World Bank 2005b, World Bank 2005c) during that same period. So in summary both private and public expenditure on education are increasing in Mauritius but the total proportion of GDP allocated to education is still relatively low by international standards.

3.1.3 Private sector & transfers

The private sector plays an important role in the provision of education in the Republic of Mauritius and most privately run schools receive financial resources from the government and like in many other countries private provision of education is higher in secondary education than in primary education (World Bank, 2002).

In 2001/02 around 11% of total public spending was given as grants to private–aided primary schools, of which 99% was transferred to the Roman Catholic Education Authority (RCEA) to pay for teacher's salaries and to meet operating expenses and 1% was allocated to primary schools for children with disabilities. Private-aided primary schools enrol around one fifth of all primary students. Only thirteen private schools, which enrol 4% of all primary students, do not receive subsidies from the government. However it should be noted in the early 2000s, a private-aided primary school received on average only 54% of the resources received by a public primary school and spending per pupil was 48% lower in a private-aided school (World Bank, 2002). Grants to private-aided schools have grown more slowly at 6.4% against 8.2% for the public schools. But private-aided schools belonging to the RCEA receive additional funding from other sources such as donations from households, the church or other religious, foreign, non-governmental organisations.

I also address the inequality arising out of the differences in funding between the private aided schools and state schools. Schools in the private sector throughout this chapter refer to both state-funded private schools and self-financed private schools. In some cases due to the unavailability of data, they cannot be separated into two categories and the analysis done throughout this study grouped both of them together and labelled them simply as 'private schools'. Nevertheless I do give details about state funded private schools, how they are funded and on what basis. Funding per pupil across all private and state schools is also given.

The resource gap between public and private-aided schools is greater at the secondary education level. Funding is skewed against private aided secondary schools and the resource gap is bridged in some cases by donations from the community, parents or other sources. However given that secondary education is free, these private-aided schools depend mostly on government subsidies[18]. Public spending on public schools has grown by 35% while those registered with the Private Secondary School Authority (PSSA) experienced a growth of only 12% in their financial resources (World Bank, 2002).

The PSSA is an agency established to regulate and allocate grants to private-aided schools. It is a major provider of secondary education. Fifty-eight percent of this transfer to PSSA (about US$ 23 million) was to pay for the salaries of teaching and non-teaching staffs, 30% was allocated to pension contributions, allowances, school grants, pre-vocational classes and the remaining 12% was allotted to managers of private-aided secondary schools (World Bank, 2002). Managers of private-aided secondary schools[19] receive payment based on the comprehensive grant formula. The grant provides operational and investment expenses based upon numbers of students enrolled. It includes an incentive component attached to student performances at examinations in the form of payments for extra recreational or sportive activities. The Manager receives a flat

[18] A private-aided secondary school receives on average a grant of US $392000 per annum, whereas a public secondary school receives an average grant of US $402000 per annum. However information about funding per pupil is not available and conclusions cannot be drawn as school sizes may differ considerably.

[19] A manager of a private-aided secondary school is usually the owner of the school and he/she receives grants for hiring his /her building to the PSSA for educational purpose. He/She is empowered to employ all staff within the school, subject to the approval of the PSSA.

compensation rate and retains any surplus as a reward of the good performance of his/her school (Ministry of Education and Science 1995).

3.1.4 Donor financing

Overseas assistance is also important for the financing of education, especially higher education. In 1998, for instance overseas funding accounted to US $ 23 million, that is, less than 1% of GDP (World Bank, 2002). Sixty-three percent of this total was devoted to enhance human resources, of which a large proportion went to tertiary education and covered the cost of scholarships for Mauritian students to study abroad. France is a major financer with its donation constituting 59% of the total overseas assistance (World Bank, 2002).

3.2 Structure of the education system

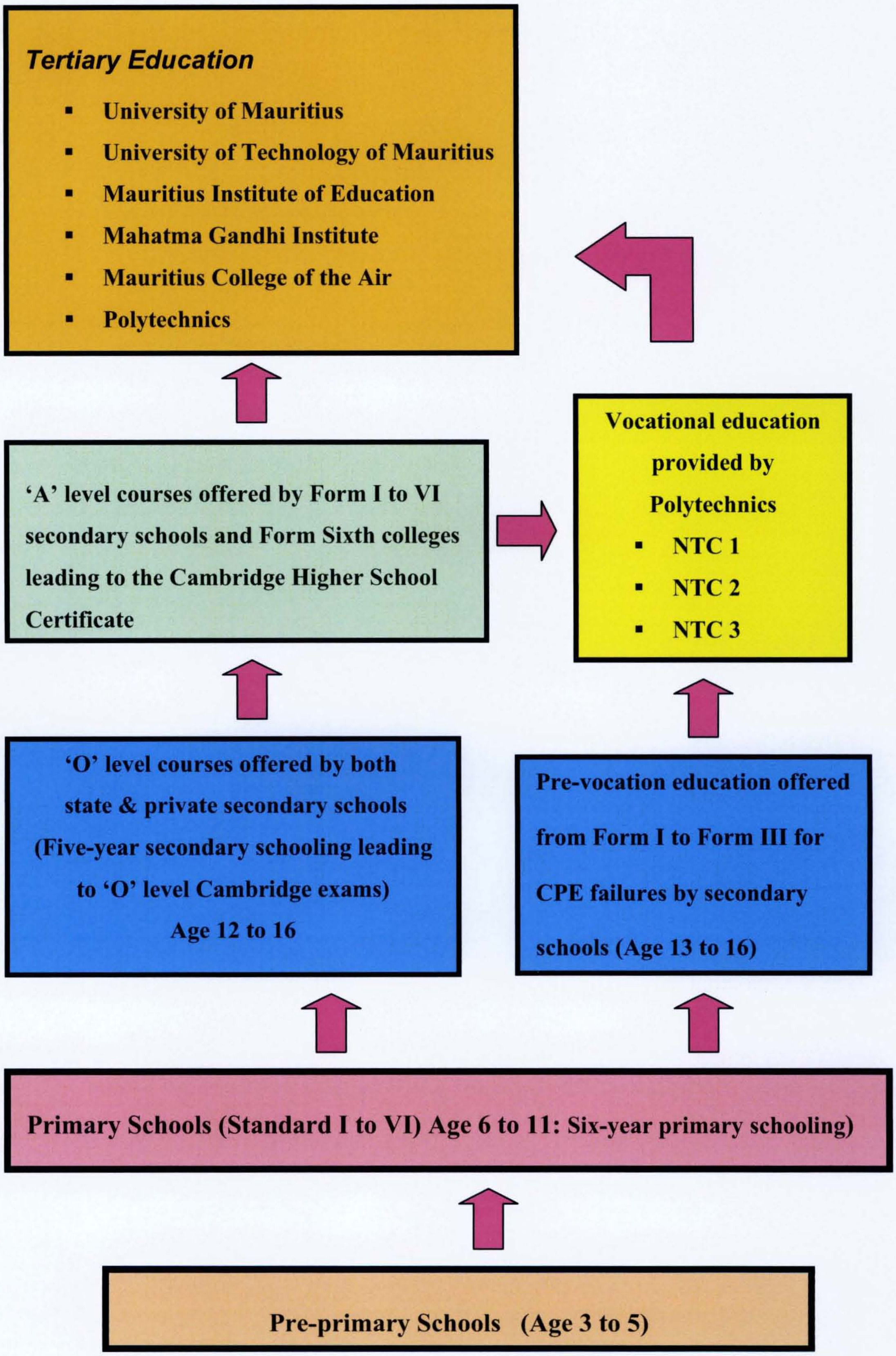
Having considered the level of financing of education in Mauritius, I now go on to discuss the institutional structure. The Ministry of Education, Science and Technology is responsible for providing education throughout the Republic of Mauritius. Although education is free, the Education Act allows private operators to provide education services from pre-primary to vocational and tertiary levels. Free education was extended to the secondary and tertiary levels in 1977 and 1988 respectively (British Council, 1974). Today education at all levels is governed by the Education Act of 1996 (UNESCO, 2000). In Mauritius due to education being state funded at all levels, every child has a period of two years of pre-primary schooling, a minimum of six years of compulsory primary schooling, either three years of pre-vocational schooling or five years to seven years of general secondary schooling leading to 'O' and 'A' level examinations after which he/ she is eligible for post-secondary education. This is illustrated in Figure 3.3. The school academic year is the same as the calendar year. On average boys have 8.9 years and girls have 9.6 years of schooling (World Bank, 2002). The gender parity ratio or the ratio of girls to boys enrolled in primary and secondary schools was around 102 in 1995 although the most recent ratio (available for the year 2001) stands at 98 (World Bank, 2005a).

Promotion to the next grade 1 to grade 6 is automatic but promotion to grade 7 requires a pass at the CPE examination. At each subsequent grade (from grade 7 to grade 11), the student must acquire the required average of marks to move on to the next grade and promotion to grade 12 requires a certain performance at the 'O' level Cambridge examination conducted at a national level.

The curricula has recently been modified at the primary and secondary levels to introduce subjects such as design technology, computer and information technology, and also to lay greater emphasis on science and mathematics. These are meant to make the education system more adaptable to future needs. The education system also caters for those who fail to pass their Certificate of Primary Education (CPE) examinations (taken on completion of primary schooling) after the second attempt. Instead of dropping out of the system, they join pre-vocational centres within secondary schools and the curriculum is designed to provide them with the basic tools required to either join the labour market after the age of 16 or to pursue a vocational or technical education.

Also the vocational education institution, IVTB was established to train workers to meet the growing demands of industries associated with the transition to a newly industrialised country. Mauritius struggles to maintain the competitiveness of its exports and to diversify its economic base (Ababa, 1997), and skill deficiencies are seen as part of this economic problem.

Figure 3.3: The present educational system in the Republic of Mauritius



3.2.1 The role of the Mauritius Examinations Syndicate(MES)

The MES is a national examining body. It conducts all examinations, for example the Certificate of Primary Education (CPE) or the 11 plus examination taken at the end of primary schooling, the Cambridge School Certificate ('O' level) taken at the end of the five years of secondary schooling, the Higher School Certificate (HSC) usually taken after two extra years of secondary schooling. It also conducts technical and vocational examinations, professional examinations for more than 50 examinations bodies and other locally organised examinations (UNESCO, 2000). The MES also acts as an examination body for distance learning education delivered by overseas institutions for different fields and levels of study.

Let us now consider education at each level in the Republic of Mauritius:

3.2.2 Pre-primary education

Various measures have been taken by the State to make quality pre-primary education accessible to every child. These include the per capita grant given to the 4 to 5 age group, the provision of additional pre-primary classes through extending existing and building new primary schools and the simultaneous development of standards and guidelines to ensure a pleasant and safe physical environment for children both in the private and public sector. According to the UNESCO report, around 64% of primary schools have a pre-school centre and 1000 private pre-schools are registered with the Ministry. Today the gross enrolment ratio for pre-primary schooling has risen to 99%[20].

The Mauritius Institute of Education (MIE) runs a Teacher's Certificate Course (TCC), accessible to all suitably qualified pre-school teacher candidates and a proficiency course through distance education for those who do not qualify for TCC. These courses are meant to equip pre-primary teachers with the necessary pedagogical skills and to give them a better insight into the psychology of children. The curriculum is designed to facilitate subsequent primary school-based learning and to develop personal and social skills.

3.2.3 Primary education

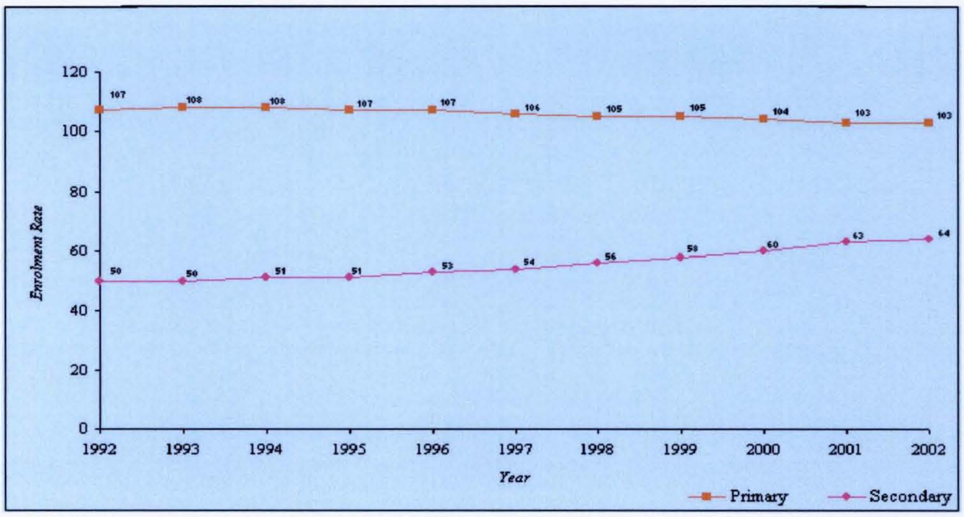
The first primary school started in 1767. Primary schools arose originally out of missionary endeavour although general education as well as religious instruction was provided. By the 1840s the Colonial government started schools of its own and also provided financial assistance to

[20] In the year 2000, the gross enrolment ratio was 95%. But the recent educational reform (2000-2003) involved the construction of new pre-primary schools and in 2003 the enrolment ratio rose by a further 4%

missionary schools (British Council, 1974). This system of aided schools operating simultaneously with government schools still exists today and it has evolved over time. Primary education is now universal.

Under regulation 37 (1) and (2) of the Education Act of 1993, all children must attend primary schools. Admission to any government or aided primary school is granted to pupils at the age of 5 until they are 13 years old. Failure to do so entails a fine or imprisonment (UNESCO, 2000). This legislation for compulsory education came into force on the 1st of January 1993 (Ministry of Education & Science, 1995). The total number of pupils attending primary schools to the population aged 5 to 11 years works out to 102% for the year 2003. The average age at which primary schooling usually starts is 6. However there are many pupils who are admitted to standard 1 when they are 5 years old. The legislation specifies that a child cannot be enrolled in standard 1 unless he/she reached the age of 5 either before or on the 1st of January of the year when the child is seeking admission in the primary school. Hence the calculation exceeds 100% and this is obvious in Figure 3.4, where the enrolment rate has consistently been above 100% since 1992 although a gradual decline over the decade can be noted. Also the gross enrolment rate for primary and secondary schools tend to converge over time – the gap between these two rates is getting smaller and smaller as the secondary enrolment rate is rising.

Fig 3.4: Gross enrolment rate in primary and secondary schools, 1992-2002 (Republic of Mauritius)



Source: CSO (2003b)

The total pupil population for primary schooling, at March 2003 was 129,616 of whom 75.5% went to state schools, 20.1% went to aided private schools and the remaining 4.4% went to non-aided private schools. Moreover around 96% of this total pupil population was within the *island* of Mauritius. Today there are around 290 primary schools and 222 are run by the State, 51 by Roman Catholic Education Authority (RCEA), 2 by the Hindu Education Authority and 15 are private non-aided schools. Admission to primary schools is based on a catchment area system (United Nations, 1999) and primary enrolments tend to follow population trends of primary school age children. A national examination is administered at the end of primary schooling and this is usually taken at the age of 11. The successful completion of grade 6 leads to the award of Certificate of Primary Education. On average, girls on both islands tend to do better than boys at CPE examinations (CSO, 2002a).

3.2.4 Secondary education

The secondary schools were originally reserved for the middle class elite and this policy was later changed, for example the Ecole Centrale founded in 1800 admitted students from other socio-economic backgrounds in 1832. But they continued to provide a grammar school type of education leading to GCE and Cambridge School and Higher School Certificates. Apart from the usual academic streams, few of them had vocational streams.

However, today the way this historically elitist system operates has to some extent been changed and the government aims at extending secondary schooling to all those who fall within the 12-19 age group. The Gross Enrolment Ratio of students attending secondary schools as a percentage to the population aged between 12 to 19 years of age works out to be around 64%. About 30% of pupils attend state secondary schools and 70% attend private (both aided and non-aided) secondary schools; the government funds nearly 80% of these private schools. Aided schools include confessional schools and schools run by individuals and groups.

Secondary schooling became free to all school age youth in January 1977, following the free access to secondary schooling law passed in 1976. Prior to this change in the law, fees were charged for each academic year of secondary schooling. These fees varied from school to school. Unfortunately data on secondary fees are not available. Research on girls' education in the Republic of Mauritius suggests that this law played a great role in extending access to secondary schooling for girls (Naugah & Poonet, 1996; Brooks, 2000).

Secondary education has two streams: the academic one and the pre-vocational one. Let us consider each separately:

- **General Education (Academic Stream)**

The Republic of Mauritius has the 6 + 5 + 2 education system where six years of primary education are followed by five years of secondary schooling and students who read for the Cambridge Higher School Certificate / 'A' level stay in secondary schools for two additional years. Admission to secondary schools is based on the pupil's performance at the Certificate of Primary Education (CPE) examination (United Nations, 1999). As mentioned earlier, Mauritius had an elitist system. Originally these were 'five star' secondary schools, which catered for the top ability students and entry into those schools were based on the CPE results. The system was examination-oriented and young children were graded and ranked in order of attainment in the subjects[21] in which they were examined. Ranking especially within the first 2000 boys or 2000 girls in the Republic, was a matter of great importance for a child's future as it determined whether or not he/she would attend the (five-star secondary schools) more academically oriented schools (ACCPUF, 1998). These pupils were most likely to go on for higher education. Generally those who passed the CPE examinations but failed to achieve the standards set by these 'five star' schools would enrol in other government or public-funded but privately run schools while those who failed the examinations after the second attempt would simply drop out.

However, after the education reforms of 2002, this highly selective system was abolished and recruitment of students into secondary schools is now based on geographical zones. The 'ranking' system has been replaced by the 'grading system' and 'star schools' have been converted into Sixth form colleges[22]. Admission to form one is now based on geographical zones. The Republic of Mauritius is divided into five zones (North, East, South, West and Rodrigues). Some schools provide education only up to the age of sixteen whereby students are prepared to sit for the 'O' level

[21] These subjects included Mathematics, English, French and Environmental studies.

[22] The 'ranking system' adds up the scores of the four main subjects of each candidate and generates a total score for each of them. Candidates are then ranked according to their total scores and the 'five star' secondary schools select the first few hundred out of thousands of candidates. The 'grading system' only provides the grade for each subject for each candidate without converting these into total scores and thus, secondary schools cannot differentiate between candidates who have similar grades.

Cambridge examinations and they can either finish schooling after Form V or join any other institutions, if they satisfy the entrance requirements, to prepare for their 'A' level.

The number of secondary schools has been increased to cater for the new system – the 'zoning' system. Some state secondary schools were set up to accommodate additional students which allowed the number of students enrolled in form one in 2003 to increase by 56%[23]. Initially in 1990, there were only 22 state secondary schools and this rose to 34 in 2000. At the same time, loans at low interest rates were given to private secondary schools so as to reduce the disparities in terms of infrastructures that exist between state and private schools. Today with the construction of additional schools, there are 175 secondary schools of which only 63 are state schools and 112 are private schools (aided and non-aided). The private schools have sprung up in response to the demand for secondary education that the government has so far been unable to meet (World Bank, 2002). Also forty-seven of these aided schools run classes up to 'A' level while only 16 state schools which offer courses up to 'A' level (CSO, 2003b).

[23] The number of students enrolled in form I in state secondary schools was only 3700 in the year 2000 but it reached 6600 in 2003.

Performances at 'O' level Cambridge examinations for the Republic of Mauritius have declined slightly in terms of percentage over the past years. This is most probably because of the percentage of the cohort taking the examinations has increased and less able students are now also allowed to take it. Also over the last seven years performance at 'A' level examinations has improved within the Republic although there was a sudden fall in the pass rate in 1999 may be attributed to the fact that the number of Rodriguan candidates who sat for the 'A' level examinations almost doubled within one year[24]. The number of candidates examined in the *island* of Rodrigues increased from 39 to 177 during the period between 1996-2002. Thus, one may suggest that the fall in the pass rates are due to the sudden increase in the number of students taking the examinations which may also include those who were less able and those who experience poor quality of education and lesser educational resources[25] available to the *island* of Rodrigues.

- **Pre-Vocational education**

The Basic Secondary Schools within state secondary schools were designed to cater for drop-outs. These schools offer pre-vocational education, linking practical with academic aspects. Pre-vocational education is provided to the less able or to those who fail the CPE

[24] There is a resource gap between the islands of Mauritius and Rodrigues, thus, simply increasing the number of candidates in the island of Rodrigues without the provision of adequate academic support to them resulted in poor performances.

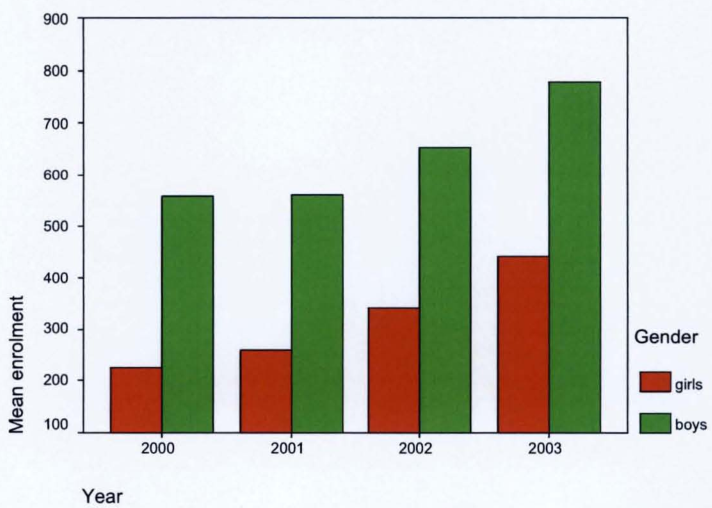
[25] Lack of appropriate educational resources such as textbooks and trained teachers may result in poor performances.

examinations even after the second attempt. It mainly caters for CPE failures who may eventually pursue a non-academic stream. This type of school was introduced three years ago to keep drop-outs in the educational system until the age of 16 after which they may either join the labour market or proceed to vocational courses. These three years of secondary pre-vocational schooling provide basic literacy and numeracy skills to these less able students and the students are even initiated to different trades. In 1997, 873 boys and 318 girls who did not attend the general secondary schools were enrolled at 20 basic secondary schools and 2 private unaided schools (United Nations, 1999).

Prior to the educational reforms in 2000, many children would simply drop out after failing the Certificate of Primary Schooling (CPE) examinations a second time. About 25% of children used to drop out and the major cause stated was their poor performance at school (Parsuramen, 1995). But since 2000, a majority of these CPE failures have joined the pre-vocational stream causing an improvement in the inter-cycle transitional rate (World Bank, 2002).

In March 2000, there were only 25 schools offering pre-vocational education and the total student population was 4695. As from 2001, the private sector, guided by the same regulations as the SSSV, took one class of those who did not pass the CPE exams leading to a total pre-vocational student population of 4919. By 2002, around 70 schools offered pre-vocational courses, 65 in the *island* of Mauritius and 5 in the *island* of Rodrigues; 21 are state schools and 49 are confessional or private schools (aided & non-aided). Moreover by March 2003, 114 schools were offering specific pre-vocational education: 109 in the *island* of Mauritius and 5 in the *island* of Rodrigues out of which 49 were state schools and 65 were private schools (CSO, 2003b). As illustrated in the figure below, there were on average more boys than girls enrolled on pre-vocational courses. The average pupil-teacher ratio for the *island* of Mauritius during that same period rose from 16:1 to 17:1 and from 15:1 to 17:1 for the *island* of Rodrigues as the latter registered a bigger proportion of the increase in the number of pre-vocational students.

Fig 3.5: Gross enrolment in pre-vocational education, 2000-2003: Republic of Mauritius



Source: Computed from CSO (2003b) data

By 2003 both the number of such pre-vocational schools and enrolments had risen by 356% and 56%, respectively as a result of greater participation from both the public and private[26] sectors.

3.3 Vocational education

Vocational education did not figure on the Ministry of Education, Science and Technology agenda until the 1970s when central schools, senior primary, junior technical and junior secondary schools were set up. Earlier vocationally training was in the form of apprenticeships in areas such as horticulture, mechanical engineering and needlework. People would learn the required techniques and skills on the job by helping the more experienced employees. The first proper technical education school was created in 1982 and no organisation was responsible for planning, monitoring and evaluating the needs for training. Co-ordination of vocational training conducted by several ministries, private centres, religious organisations and consulting firms was practically non-existent and it was not possible to bridge the gap between the education system and the world of work. The Industrial and Vocational Training Board (IVTB) was set up in 1988 and was given the role of the lead agency of the government to deal with this chaotic situation. The responsibilities of

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[26] Secondary schools offering pre-vocational classes could only accommodate around 1900 students in 2000 but in 2003 this figure reached 3300.

this Board as a corporate body are to advise the Minister on issues related to training and to monitor training in consultation with the relevant authorities. It must also administer, control and operate training schemes and provide assistance for the training needs of people who are or will be employed in commercial or vocational fields (Munbodh, 1996).

The 1980s was a period of rapid economic growth whereby the mass of unemployed people was easily absorbed within the economy. The unemployment figure, which stood at more than 12% prior to the 1980s, was reduced to only 1.8% within a decade. A near full employment situation prevailed in Mauritius. Industries which earlier demanded less skills, less complex technology and which had a ready source of available manpower, now required multiple skills and were faced with a situation of near full-employment by the 1990s. These resulted in wage pressures, loss of competitiveness of domestic products and increasing competition from other low-cost suppliers, especially from African and Asian countries. Moreover the situation of full employment was not uniform in all sectors (United Nations, 1997). Thus, emphasis was laid on vocational education to improve labour mobility, adaptability, productivity and to restore the firms' competitiveness. The situation advocated the need for change in the quality and content of education from its present academic emphasis to a more technical orientation at all levels in order to create skills that would meet the demand generated by prospective economic development[27].

The IVTB was set up to promote training and apprenticeship of persons to be employed in technical and vocational fields. It had 17 centres with 1211 full-time students and 2355 part-time students in 1997. It is funded by a grant from the government and a one per cent of basic payroll levy paid by the employer. The IVTB came into operation in 1989 and promoted training on all fronts at the national level. Its objectives are to integrate government's manpower resources, vocational training programmes and to ensure that skills training remains ahead of new technology. Moreover students after 1988 could combine subjects from the academic stream and technical streams at the Cambridge School Certificate level. There has been a positive change of attitude in favour of vocational education and technical subjects such as fashion and fabrics, food studies, geometrical and mechanical drawing, geometrical and building drawing, woodwork, metalwork, design and technology and design and communication. Today vocational education is conducted in a large number of secondary schools.

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27 The creation of the Ministry for Human Resources, Development and Reform Institutions was designed to ensure that skills formation remained abreast of new technology by reviewing periodically projected manpower needs as opposed to current manpower resources and matching the needs of industries and individual clients with relevant quality training programmes (United Nations, 1997).

However historically the education and training system has been divided and the training system operates under the responsibilities of the Ministry of Education as well as other various ministries. So the Management Trust Fund was created in 1990 to co-ordinate and monitor technical and vocational education. Moreover the Technical school (Management Trust Fund) Act of 1990 stated the following objectives for its creation:

- manage technical education centres operating under its responsibility
- organise and run technical education courses at the centres
- promote technical education
- advise the minister on short and long term plans for technical education and on the need for appropriate research in the field of technical education (Atchorena 1996: 88)

In 1991, an Education Sector Master Plan was prepared to make the education system more efficient and to bring education in line with the development needs of the country. The IVTB operates many Vocational Training Centres and training is provided in a variety of trades starting from automobiles, to jewellery and electronics.

Vocational training is also offered at post-secondary level. The formal training consists of the IVTB and private training institutions. The entry requirements to these vocational training courses are a minimum of three years of secondary schooling and an age of 16 years and above. Those trainees who successfully complete one year of full-time training in IVTB centres are awarded a National Trade Certificate, level 3 (NTC 3). They may then proceed to National Trade Certificate, level 2 (NTC 2) and eventually to National Trade Certificate, level 1 (NTC 1). The private training institutions also provide training leading to internationally recognised awards from institutions such as the City & Guilds of the London Institute, the Pitman Institute, Chartered Institute of Transport and the Institute of Marketing. Also those who have finished their five years or seven years of secondary schooling may enrol at Lycée Droopnath Ramphul or Lycée Sir Guy Forget to acquire vocational education. Courses offered at these lycées include automobile mechanics, mechanical production, electronics, building construction, programming, system analysis and business administration. The full-time courses in registered training institutions, which are primarily meant for school leavers, are also attended by some sponsored workers. Nevertheless the part-time courses offered after normal working hours are attended mainly by sponsored workers. The apprenticeship system is based on the German dual model whereby the apprentice spends 1½ days per week in a training institution and he/she is coached by a tutor in his/her enterprise for the rest of the week. Even the University of Mauritius adopts a similar system for some of the courses offered such as Management, Accounting and Engineering.

Students are sent for training for a minimum period of two months during vacations. These are meant to foster the industry-training link and to promote on-the-job learning.

3.5 Tertiary education

The gross tertiary enrolment rate for 2002 is estimated at 16.7% (TEC 2003a). However this figure has been computed after adding the number of Mauritian students studying abroad as they constitute a significant proportion of the total tertiary student population. Also the gross tertiary ratio refers to the number of students enrolled at the tertiary level even if they do not belong in the relevant age group as a percentage of the population in that specific age group 19-24 years. Here the age group base is larger than what is prescribed, that is, 19-24 years instead of 20-24 years.

Post secondary education within the Republic of Mauritius is provided by six different types of institutions namely the University of Mauritius, the University of Technology of Mauritius (UTM), the Mauritius Institute of Health (MHI), the Mauritius Institute of Education, Mahatma Gandhi Institute (MGI), Mauritius College of the Air for distance education (MCA) and three polytechnics [Swami Dayanand Institute of Management (SDIM), Sir Guy Forget Polytechnic (GFP) and Institut Superior de technologie (IST)]. These are all publicly funded institutions and there are some private providers as well. The number of students enrolled in private and publicly funded tertiary institutions increased by 20%[28] by 2003.

Although the UOM accommodates many students and offers various courses and there are many other institutions offering post-secondary courses, Mauritians still go out of the country to study and the latest data available for 2003 shows that over 3000 students left Mauritius to study abroad and the majority went to France/Reunion followed by 625 students in India and 532 in the UK. The number of students in Mauritian tertiary institutions was 17200 in 2003.

3.5 Efficiency of the education system

There are a number of potential indicators of the efficiency of the system, including the repetition rate, the promotion rate and the drop-out rate. The repetition rate is the proportion of students who repeat a grade once or twice It is measured by dividing the number of repeaters of a particular grade at year (t+1) by gross enrolment for that particular grade at year t (Wako, 1995). A high repetition rate indicates low internal efficiency as access may be denied to those who could not enrol due to unavailability of

[28] The number of students in tertiary institutions has risen from 14300 in 2000 to around 17200 in 2003

places[29] and resources of the system are strained. In the Republic of Mauritius data on drop outs are not collected, hence the drop-out rate is derived when the repetition rate is subtracted from the promotion rate (Wako, 1995). The promotion rate is the proportion of those students who completed a particular grade successfully and proceeded to the next grade in the following year. Drop-out rates measure the ratio of students who abandon schooling during a particular year. High drop-out rates indicate low internal efficiency or high input/output ratios.

In the Republic of Mauritius, the primary school cycle operates with a higher degree of efficiency compared to the secondary school cycle which is beset with high drop out and repetition rates (World Bank, 2002). However emphasis must be laid on the fact the retention rate depends largely on the educational policy in place and the Republic of Mauritius, like the UK has an automatic promotion policy within the primary schooling system. Pupils are promoted automatically up to grade 6. Moreover given that examination papers at the end of grade 6 are marked locally and the national curriculum is designed internally, reducing standards to enhance promotion rates within primary schooling and transition rates between primary and secondary schooling may be possible.

In an efficient education system, all intakes go through various grades to complete the primary and secondary school cycles in 6 and 7 years

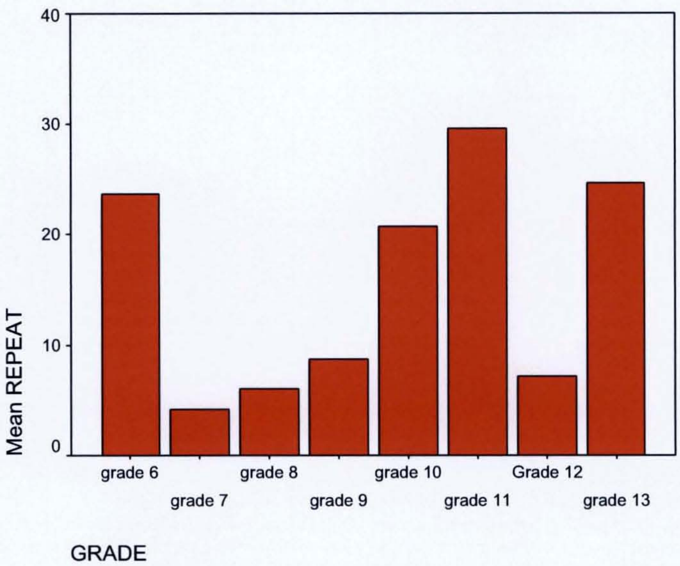
[29] The places are occupied by repeaters.

respectively. If students drop out or take more than 13 years to complete their schooling, this indicates that the system is less efficient. Drop-outs leave the system without acquiring adequate qualifications and repetition leads to wastage of educational resources (World Bank, 2002).

The repetition rate for the year 2003 was on average 4.3% for primary schooling and 13.5% for secondary schooling. Repetition rates for both primary and secondary schooling have been constantly falling during the last twelve-year period: 1991-2002 (CSO, 2002a). Nevertheless repetition rates have remained high between grades. As shown in figure 3.6 below, the repetition rate is highest at the end of grade 11, followed by grade 13 (Upper six) and grade 6 (end of primary schooling). Many pupils usually repeat grade 6 either because they have failed the CPE examinations or because they want to improve their CPE results so that they could secure a seat in a five-star secondary school[30]. Many students also repeat grade 10 (Form 4) so as to prepare for the 'O' level Cambridge examination the following year.

[30] Note that this elitist system was abolished only in 2003 and this analysis uses data prior to this abolition.

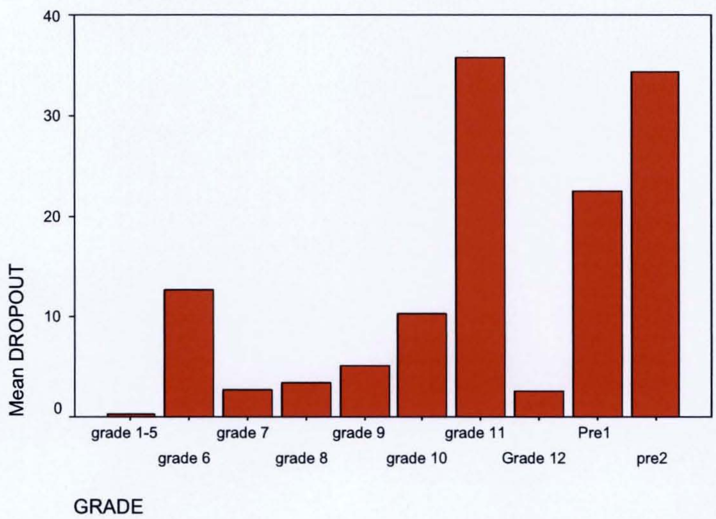
Fig 3.6: Repetition rate over 1991-2002: Republic of Mauritius



Source: Computed from data collected at the statistics department of the Ministry of Education, Mauritius

The drop-out rate for primary schooling for the Republic of Mauritius was estimated at 0.5% for the year 2003 and as can be concluded from Figure 9, the drop-out rate for the Grade 1 to 5 within the primary school cycle is on average close to zero. But during the same period 1991-2002, the drop-out rate during the final year of the primary cycle, that is, at grade 6 was high. Later during the secondary schooling cycle, the drop-out rate is lower at all grades until grade 10 (Form 4) and is highest at the end of the five-year of secondary schooling, that is, at Grade 11. Also the drop-out rate has been high even for the pre-vocation classes, years 1 and 2. The drop-out for the primary and secondary schooling cycle had a downward trend during 1991-1997 but it suddenly went up in 1998 due to high drop-out rates in prevocational courses. This alternative educational stream was introduced in 1997 to keep children within the education system until the age of 15 and it is likely to have high drop-out rates due to the nature of the students taking these courses. Figure 3.7 again illustrates the high drop-out rates at the end of the first two years of the pre-vocational courses (Pre1 and Pre2). These courses last for three years but most of the students drop out at the end of the second year itself at the age of 15/16.

Fig 3.7: Drop-out rate over 1991-2002: Republic of Mauritius



Source: Computed from data collected at the statistics department of the Ministry of Education, Mauritius

Recently the World Bank (2002) conducted a study to assess the education system within the Republic of Mauritius. The survival rate was calculated. It was found that out of every 100 boys and 100 girls enrolled in grade 1, only 39 boys and 46 girls reach grade 11 (the end of the five year secondary schooling) while only 13 boys and 16 girls reach grade 13 (the final year of the seven year secondary schooling). It was reported that very few pupils drop out or repeat during the cycle of primary schooling when compared to those in the secondary school cycle. The rate of transition[31] from primary to secondary school has been estimated at an average of 65% for girls and 75% for boys. Transition rates are low within secondary schooling from grade 11 to grade 12, that is, at 38% for boys and 42% for girls and only 13% of boys and 16% reach the final grade of the seven-year secondary schooling. In other words 40% drop out during transition between primary and secondary school cycles while 38% drop out within secondary cycle and the remaining 22% leave schooling after the 'O' level Cambridge examination. These are very high drop-out rates and have huge implications for the average skill levels of the work force. Thus, the Mauritian government should not only improve transition rates between different school cycles, it must also improve the survival rate within secondary education. Also a pool of students is leaving the secondary school cycle with incomplete schooling and this reduces the number of qualified students for admission into post-secondary education.

As has been said, a system is also inefficient if students drop out or take more than the required years to complete the school cycle (World Bank,

[31] These calculations are net of repeaters and also include students who would previously drop out of the education system after failing the CPE examination twice. They are now included in prevocational classes.

2002). As can be deduced from Figure 8, the pattern of repetition in secondary schooling is similar to that in primary schooling whereby a larger fraction of students repeat the last grade (Grades 6 and 11). Repetition of grade 11 of the lower secondary schooling improves the probability of students of joining the upper secondary classes. Table 3.1 provides internal efficiency ratios for the performance of public and private-aided schools in the Republic of Mauritius.

Table 3.1: Student flow efficiency indicators in the Republic of Mauritius 2001

	Inefficiency due to repetition and dropout
Primary cycle	
Public schools	0.82
Private-aided schools	0.81
Total primary	0.85
Secondary cycle	
Public schools	
Private-aided schools	
Total secondary	0.27

Source: Adapted from World Bank (2002)

Table 3.1 was calculated using patterns of survival and grade repetition to estimate the internal efficiency of the education system. This methodology compares the resources actually used by the system to produce its graduates with the resources it would use if there were no drop out and no repetition. If the primary school cycle starts with 1000 pupils, only 694 will complete the 6 years of primary schooling successfully. If infinite repetition is allowed, 106 students would graduate in 7 years, 16 students in 8 years and so on. In Mauritius, the total number of student years currently needed for all students to complete grade 6 successfully is 5061 years. If there are no drop-outs and no repetitions, it would take 694 students 4164 years to graduate in 6 years (694x6). Hence with drop-outs and repetitions in the primary education cycle in the Republic of Mauritius, the internal efficiency is estimated at 82.3%[32] and if the same method of calculation is applied for the secondary education cycle, secondary schools will operate at only 27% of their optimal efficiency (World Bank, 2002).

Using these data on repetition and drop-outs, the World Bank estimates that a waste of resources amounting to US$6 million in primary and US$ 9 million in secondary occurs annually in the primary and secondary education system of Mauritius. This amounts to a total loss of 10.3% of the entire recurrent budget of the Ministry of Education and Scientific Research (MOESR) for 2001 (World Bank, 2002).

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[32] (4164/5061) x 100

Efficiency ratios for private-aided secondary schools could not be calculated due to lack of data on drop-out rates in those schools. However the report points out that repetition rates are higher in private-aided schools, implying that they may be less efficient. Nevertheless emphasis must be laid on the fact that private-aided schools are poorly funded and public schools have always enrolled more able students (in terms of good CPE results and good 'O' level results). Hence it may not be reasonable to term private-aided schools as 'less efficient' relative to public schools unless the analysis done by the World Bank (2002) adjusts for the quality of intakes.

Moreover one must be cautious when interpreting the results generated from the study conducted by the World Bank (2002). Because the measures they use to assess the efficiency of the Mauritian education system takes no account of education quality and does not relate to the costs of achieving a reasonable standard. Also it would be inefficient to have a survival rate of 100 % if learning does not take place at school.

3.6 Equity issues

- **Gini co-efficient on public expenditure**

Inequity in schooling arises as a significant proportion of school age population drop out of the education system and access to education is unequally distributed across the population. That segment of the school population is forced to withdraw and lose access to public spending on education. This gives rise to inequality as the government collects taxes from all segments of the population and those who drop out cannot realize personally the full benefit of public spending on education. As discussed in the previous section, the secondary education cycle is inequitable as a significant proportion of the population aged 12-19 drops out every year. But with the introduction of pre-vocational education, more students are able to continue their education for at least three years thereby reducing the inequity.

Also, disparities between public spending on state schools and private-aided schools were highlighted earlier. Students who therefore attend private-aided schools do not enjoy the same amount of resources as do those who attend state schools. Data from other countries suggest that a major fraction of students in private aided schools come from poor rural families but due to lack of data this cannot be confirmed for the Republic of Mauritius. Biases in favour of urban areas or upper-income households for secondary schooling cannot be ruled out (World Bank, 2002).

Total benefits enjoyed by any member of the society depend on the length of time he/she is able to survive in the education system. Any member of the society who drops out of the system, stops deriving benefits from the public spending that is made on education. It is evident from earlier discussions that very few students survive through the school system to continue post secondary education. Also, given the fact that unit costs in higher education are 4.7 times higher than that of primary education, a minority of students capture a significant share of funding allocated for education.

In a study conducted by the World Bank (2002), a pattern of spending across a cohort is created which uses information on survival rates to plot the progression of survivors across the education system. If a cohort starts with 100 members in grade 1 and everyone is promoted to grade 2, then according to the per pupil spending in primary education, the total benefit accruing to a member would amount to 0.11 times the per capita GDP. Completion of the primary school cycle by the 100 members would result in 0.66 times per capita GDP and if 30 members drop out after this completion, then their total benefit is 19.8 times the capita GDP (0.11x 6x 30). Thus, it is possible to calculate the cumulative distribution of benefits accumulated by members of a cohort as they exit the education system. The study also reports that 28% of any given cohort in Mauritius completes only six years of education and they use 14% of total public spending. Thus, the incidence of education spending in the Republic of Mauritius is not perfect. The study reveals that 20% of the most educated in a cohort receive 35% of all public spending on education and is also biased in favour of the highly educated. The gini co-efficient is estimated at 0.3 suggesting a relatively biased structure of expenditure on education.

However one should be cautious while using these results as they are based on the survival rate that was computed and based on gross enrolment rates. These enrolment rates were given the same weight across each grade and this results in an overestimate as a larger number of students are in lower grades. Most students drop out in later years. Moreover the existence of high repetition within the education system inflates the value of the gross enrolment rates. The numerator includes all children in a cycle irrespective of age while the denominator includes only the number of school age-children in the cycle. Thus, the numerator has a considerable number of over-age students.

- **The Principles of 'Zoning'**

Historically, parents have favoured public secondary schools rather than private-aided secondary schools (World Bank, 2002). Although this highly selective system was abolished in response to the inequity in the Mauritian educational system, the education reform still provides a strong foundation for maintaining the elite schooling system. Instead of moving towards mixed ability schooling, the reform merely redistributes the more able into 'star' schools (which are mostly state schools) located in their respective geographical zones. Prior to the education reforms of 2002, state schools used to select more able students (that is, those with good CPE results) and today more able students are still enrolled but this selection is now restricted to geographical proximity. However parents can take the decision about whether or not their children will attend the particular school allotted by the state. There is some degree of parental choice.

The education reforms of 2002 led to the setting up of around 30 state schools providing general and technical education up to Form V and Form VI (Form Sixth colleges) catering to 'A' level students only. Many existing state and private aided schools were converted into either lower secondary schools (teaching up to form V only) or into Form Sixth colleges. The 'star' schools were usually converted into Form Sixth colleges (Ministère de l'Education et de la Recherche Scientifique, 2004). The setting up of these colleges were supposed to eliminate duplication and inefficiency in the educational system by grouping qualified teachers and other resources most suited to the needs of 'A' level students. Instead of making these scarce resources available to many schools around the islands, the Ministry thought it best to come up with the Sixth Form Colleges. Qualified teachers (especially those holding a degree) were redeployed from schools converted into lower secondary.

Here 'zoning' is seen as a purely administrative regulatory device to secure the most efficient allocation of resources and to be able to respond to the changing pressures and demands through technical adjustments to the system (McCulloch, 1991). However zoning may also be seen as a protectionist device that reduces the contestability between schools as the Ministry of Education will automatically assign students to schools, according to their grades but within their respective geographical zones. The principle of zoning may thus reduce incentives of schools to improve standards and increase accountability as they no longer need to 'market' themselves to parents. When it comes to 'choice', zoning reduces the ability of parents and students to select the best school. Moreover 'zoning' may just serve to increase social inequity by entrenching the privileges of older established schools and of families in prosperous areas of the country. Some schools especially private-aided schools in disadvantaged areas will be in danger of becoming unviable as they lose pupils to newly established State schools with superior resources. Similarly schools with a high proportion of 'less able' students in terms of their CPE results may be at risk of becoming 'ghetto schools'.

3.7 Concluding note

Due to unavailability of data, social class and inequity issues were only partly incorporated into the discussion. However this chapter tackles the major issues relating to the education system in the Republic of Mauritius.

The key findings are firstly, that repetition rates tend to be high for the same forms associated with high dropout rates which may be explained by the fact that these are key grades in the system whereby pupils need to achieve 'reasonable' standards before they can proceed further. There are serious problems of repetition within and drop-outs from the educational system at Standard Six, Form IV, Form V and Upper Six. These suggest inefficiency in the education system and they should not be left unchecked. Besides the World Bank (2002) suggests that the primary and secondary systems operate at efficiency levels of only 82 % and 27% respectively (see the section on efficiency of the education system).

The second main issue is the elitist nature of the system. Nonetheless, for reasons discussed earlier in the Chapter, the zone system did not shift Mauritius to a mixed ability school system. Originally, 'five star' secondary schools dominated secondary schooling in the Republic of Mauritius. As a result, the system was too examination-oriented and young children were ranked in order of their CPE results and these were important determinants of a child's future. However the Education Reforms of 2002, abolished this system and replaced it by the 'zoning' system to make the education system more equitable. Nonetheless, for the reasons discussed earlier in the chapter, the zone system did not shift Mauritius to a mixed ability school system.

A third issue is the growing importance of vocational training in Mauritius. The IVTB was set up to co-ordinate and ensure that training remains ahead of any technological change so that the Republic of Mauritius could compete in the international market and also so that workers could be equipped with the appropriate skills. The importance of vocational education is stressed so that there will be no mismatch between the workers' skills and demands for skills by employers. The setting up of the pre-vocational section within the secondary schooling system itself ensures that students acquire the basic skills that will allow them to move on to vocational training programmes leading to NTC3, NTC 2 and NTC1.

A fourth issue is the nature of tertiary education in Mauritius. Many students still continue their higher studies abroad although the University of Mauritius and other recognised institutions within the island provide degree courses. This level of studying abroad may be explained by the relative scarcity of places available within the island compared to the increasing number of students who follow higher education courses. All publicly funded institutions play an important role in the provision of tertiary education and it was highlighted that distance education still provides for 30% of the total tertiary student population.

In summary, the government appears therefore not to be spending enough on the education. This was highlighted during the discussion of the section on efficiency. The education system is inequitable such that funding is skewed against private aided schools. Even the principle of zoning which was supposed to do away with the concentration of high ability schools has not moved towards a mixed system.

The next chapter discusses how the main data set, from which a sample will be used to estimate the social returns to levels of qualifications for the Republic of Mauritius, were collected and edited. It will also address some methodological issues. The justification for using all main variables together with the final sample size for the purpose of this study will be provided.

Chapter 4: The 2000 Population Census data Set and Earnings Differentials

4.0 Introduction

The purpose of this chapter is to understand how the 2000 Population Census data was collected and to assess its reliability, and validity. All calculations to estimate the social returns to education will thus be based on the data available from the most recent Population Census. The 2000 Population Census data provide a snapshot of individuals with different characteristics along with their earnings at a point in time.

This chapter is divided into two major parts. The first part deals with the quality of the data set and the sample size to be used for estimation purposes while the second part presents earnings differentials by sub-groups of the sample along with variables such as qualifications, age, gender and tenure. In Section 4.1 I present how the 2000 Population Census data was collected with much emphasis laid on the reliability of the data set. Section 4.2 looks at the accuracy of the data set while its internal consistency is assessed in Section 4.3 and the reliability and validity of the 1% sample of the original data set are discussed in Section 4.4. Section 4.5, on the other hand, provides the justification for the 'working' sample and the eventual use of all main variables in the computation of social returns to different levels of qualifications. Section 4.6 provides the descriptive statistics for the sample as a whole and Section 4.7 examines workers' characteristics by gender. Workers' characteristics are analysed further by sector of employment in Section 4.8 and by place of residence in Section 4.9. Finally Section 4.10 concludes this chapter.

Much emphasis is placed on the data collection process in this chapter because data is often of low quality in developing countries, especially lower income countries. Information about individuals has been either poorly collected or subjected to huge sample selection problems (Bennell, 1994; Psacharopoulos, 1996)[33]. However the Republic of Mauritius is an upper-income country and as will be discussed in this chapter, the data set that I use in this thesis to estimate the social returns to education, may not be very rich but is of good quality and satisfies the required methodological ground rules.

[33] Some of these problems were discussed in Chapter 2.

The 2000 Population Census data Set

4.1 Collection of the 2000 Population Census data

The first complete census that was taken in Mauritius dates back to 1735 when it was still a French colony. Since then a number of censuses have taken place with the one in 1931 being followed by another one every ten years, except for the one due in 1941 postponed to 1944 with the outbreak of the Second World War (CSO, 2002a). The Population Census 2000 is the seventeenth for the island of Mauritius and the island of Rodrigues. The Population Census 2000 was taken in two rounds. The first round, the Housing Census was designed to obtain a list of names and addresses of heads of households to eventually serve as a frame for the Population census. The Housing Census was conducted four months prior to the Population Census or from the 7th of February to the 18th of June 2000 while the latter was conducted from the 19th of June to the 16th of July 2000. The Population Census enumerated all those alive at midnight on the 2nd of July 2000 (CSO, 2002a). Both censuses were conducted on all islands[34]: Mauritius, Rodrigues, Agalega and St Brandon[35]. The Housing census enumerated all buildings, housing units, households, commercial

[34] The Republic is made up of the main island of Mauritius, the island of Rodrigues and several islands located within 350 km from the main island.

[35] The island of Rodrigues is administered by the Ministry of Local Government, Rodrigues and, Rural and Urban Development. The other islands are administered by the Ministry of External Communications. In the Population Census 2000 data set, Rodrigues and the other islands are wholly coded as rural.

and industrial establishments, hotels and boarding houses and even fruit trees of bearing age on residential premises! The Population Census enumerated all persons present on census night (as well as all residents who were absent on census night) in all households and communal institutions. Wholly absent households who were not in Mauritius on Census night were not enumerated and are excluded (CSO, 2002a).

The census was based on the Statistics Act of the 7th of April 1951. This Act empowers the Director of Statistics to request for the collection of any information relating to censuses and it also ensures that any person who refuses to fill in the prescribed forms or to supply the required information or knowingly makes false statements is liable to prosecution. At the same time, strict rules are laid down to guarantee confidentiality and every person employed in connection with censuses takes an oath of secrecy before a magistrate. Any breach of confidentiality is accompanied by penalties. Census field officers are provided with an authorisation card, signed by the Director and it is produced during interviews for the censuses.

There was a publicity campaign started in February 2000 to convince the population about the usefulness of the census and to appeal for their co-operation. Wide coverage of the event included information broadcast via radio and television during hours of high audiences in three different languages: Bhojpuri, Creole and French. Also during his brief interventions on radio and television, the Director of Statistics covered the objectives of the census and the confidential aspect of the information collected.

As has been said, two sets of data were initially collected by the Central Statistics Office: the 2000 Housing Census Data and the 2000 Population Census data. Housing and population enumerations were conducted on the islands of Mauritius, Rodrigues and Agalega except for the St Brandon islands where only a count of persons spending the census night was made as these islands are fishing stations with no resident population (CSO, 2002a). All areas were adequately covered with the island of Mauritius consisting of both urban and rural areas while all the other islands were catergorised as rural only. Some 37,5000 Population Census questionnaires were printed and about 300,000 Population Census forms containing around 1,200,000 entries across all geographical areas[36] were coded and edited (CSO, 2002a) amounting to a response rate of around 99%[37]. The project value of the census was Rs 75 millions but, given the availability of existing infrastructure, services and human resources, the actual census budget turned out to be Rs 70 millions[38].

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[36] The Republic of Mauritius being very small geographically does not have remote rural places from where census information may not be collected as residents are concentrated on the islands Mauritius and Rodrigues.
[37] Population estimated in 2001 was 1,205,667 and there was an annual growth rate of 1% which implies that population in 2000 stood at 1,193,610 resulting in the response rate of 99.46% (CSO, 2002a).
[38] At the exchange rate of 1 GBP = 53.7852 MUR, the estimated project value was £1,394,387 but the actual cost was £1,301,474.

The 2000 Population Census questionnaire is an improvement over the 1990 Population Census for the purposes of my research. The questions on education in 1990 Population Census were reviewed to include qualifications, rather than just questions about primary and secondary schooling and a question on income for persons aged twelve and above was added (CSO, 2000). However the 2000 Population Census data set only provides total cash income in rupees received by the individual from all sources for the month of June 2000.

A population census form, with the name and address of the head of household as well as other geographical information, was prepared for each private household enumerated at the Housing Census. Addressed population census forms were also prepared for hotels, institutions, collective quarters, vacant housing units and housing units that were under construction.

Enumerators were given a list of addresses to be visited along with the geographical identification codes needed to identify households and an addressed population census form for each of these addresses which they had to deliver personally. They also carried some unaddressed forms for newly-formed households and those that could have been missed at the Housing Census. They kept a formal record of these names and addresses. Each enumerator distributed the Population Census 2000 questionnaires to the heads of each household during the week preceding the Census night of the 2nd of July 2000. They were instructed to insert appropriate remarks during distribution for each entry on the list of households provided to them so that during the collection stage they could keep track of whether the questionnaire was delivered and subsequently collected, whether a particular household had moved to a new address or whether a previously vacant housing unit was now occupied.

Moreover they had to guide about 50-75 households 3 to 4 days before the Census night and they had to call on each of the households after the Census night to collect the questionnaires after ensuring that they were correctly filled in. They were also instructed to fill in the questionnaires either partly or wholly for those unable to do so and to return these to the Chief Enumerator ensuring that the information these contained were legible, consistent and complete (CSO, 2002a). In order to correct for errors and to obtain missing information, they had to call back the appropriate households. Completed forms were collected on the 3rd of July 2000 and this exercise lasted until the third week of that month. Enumeration of foreign workers was done with the assistance of the responsible factories officers where these foreigners were working.

4.2 Accuracy of the 2000 Population Census data set

4.2.1 Enumeration Areas

The main island, the island of Mauritius, is divided into nine administrative districts[39], and consists of both rural and urban areas. Enumeration divisions were based on the Municipal Wards (MW) and Village Council Areas (VCA) used at the 1990 Population Census, as these constitute administrative regions for which data would be most relevant. Further sub-division into census enumeration areas (EAs) was carried out by splitting the MWs and VCAs to create well-defined clusters with easily identifiable boundaries such as roads, lanes and so on, and so that each EA contained an equal number of households. EAs on average contained about 75 households in rural regions and about 90 in urban regions, although the number of households in some EAs varied from 0 to 260. The island of Rodrigues was totally defined as rural and split into EAs consisting of 85 households on average with the range of variation being 0 to 225 households. There were 3472 EAs on the main island, 93 in Rodrigues and 1 in Agalega.

[39] Nine administrative regions consisting of Five Municipal Council Areas (MCA) and four District Council Areas (DCA) which may be further spilt into Municipal Wards (MW) and Village Council Areas (VCA) respectively.

Although census enumeration maps used for the 1990 Population census were retained, these needed further updating. Field visits were conducted prior to 2000 to assess considerable development in terms of new settlements. Updating of census maps were done after the completion of field visits, and these included the relevant geographical districts, MW or VC areas and EAs.

Geographical divisions were designed to follow a hierarchical structure so that the software used for tabulation could produce tables at any defined geographical level and there were cases where 25 VCAs extended over 2 or 3 geographical districts. Each EA was identified by a six digit code comprising of the island code (1 digit), the geographical district code (1 digit), the municipal ward or village council area code (2 digits) and the enumeration area code (2 digits)[40]. The two digits codes of the municipal ward or village council area when associated with the relevant district and island codes gave the relevant MW or VCA identifiers made up of 4 digits. These further combined with a particular enumeration area code allowed an EA to be uniquely identified.

[40] In cases where geographical sub-divisions such as electoral constituencies and localities were used, geographical hierarchies other than the ones stated in the text were designed.

4.2.2 Enumerator and Supervisors during fieldwork

A total of 6225 field officers[41] were recruited on a part-time basis for the census field operation which in some cases lasted over a period of nine months (CSO, 2002a). Before the start of the Population Census 2000, senior supervisors and supervisors trained Chief enumerators and enumerators respectively. For each category training lasted for six hours with attention paid to the instructions manual, the Census guide and instruction booklets. As part of their training, they were asked to fill in a population census form for their households and to discuss the problems that they encountered during the exercise.

Also during the census, to ensure that all interviews were properly conducted and that all concepts were well understood, supervisors had to accompany each of their enumerators during their first visits to households. Surprise and pre-arranged field checks as well as re-interviews were also done. Supervisors also had to check all completed questionnaires at the early stage of enumeration and later a sample of the completed questionnaires was checked to ensure that the quality of work done by enumerators was adequate. Meetings were held regularly to solve problems encountered on the field and to assess the situations on the field. Thus, much emphasis was laid upon the training of field workers, daily

[41] These include 1 Chief Supervisor, 2 Assistant Chief Supervisors, 17 Senior Supervisors, 143 Supervisors, 1113 Chief Enumerators and 5057 Enumerators.

control and supervision of the fieldwork to increase the reliability of the information collected. Also to ensure that supervisory control prevailed throughout the fieldwork, supervisors were required to keep a dated record of daily activities outlining the activities carried out, the problems encountered and the remedial actions taken (CSO, 2002a). Thus, the supervisory staff could follow the progress of fieldwork and assess the performance of all enumerators working under their supervision.

4.2.3 Coding and editing procedures

Coding and editing of data started in September 2000 and was completed in July 2001. Editors and coders were trained both in small groups and as members of teams by the statistician in charge. Completed questionnaires were tagged together in batches according to their respective enumeration areas (EA) and they were returned to the census storeroom after verification. Control forms were used to record the EA number of the batch, the date of reception, the name of the officer who returned the batch and the relevant counts covered for that particular EA. Again control sheets were used to record the processes the EA batches went through, that is, from the storeroom, then to the editing and coding sub-unit, followed by the Central Information Systems Division (CISD) for data entry, and finally back to the storeroom. These control sheets ensured that batches of all EAs completed the various stages. Data for around 300,000 Population

Census forms containing about 1,200,000 records were keyed in during that period (CSO, 2002a).

4.3 Internal consistency

The Housing Census 2000 data set was used to check the consistency of the 2000 Population Census data. During the early stages of data collection, that is, when the census questionnaires were being collected, enumerators were asked to compare the resulting person count for each household with that obtained previously at the Housing Census and they had to explain any resulting differences.

All EA batches were verified to ensure that all census forms in a given batch had the same EA codes. Other checks included the verification of the presence of only one 'head' per household, consistency between age and date of birth, consistency between age and marital status, consistency between age and educational attainment. Each questionnaire was handled by two officers with the first one performing the overall verification of the EA batch together with the editing and coding of the part of the questionnaire involving simple operations. Second officers edited and coded the complex part of the questionnaire and they were chosen on the basis of their ability to understand the different codes involved. This procedure resulted in a reduction in the number of coding errors (CSO, 2002a).

A validation programme that verified field consistencies was run to identify records with errors. These records were listed and the relevant questionnaires were retrieved to make the necessary corrections and to update the data files. Validation on the 2000 Population Census data files was carried out on completion of the editing and coding exercise. Validation was carried out on Housing Census 2000 data files as well and a preliminary set of publication tables was produced using the country data file[42]. The tables produced confirmed that the Housing Census 2000 data required no further editing. However the same could not be concluded for the 2000 Population Census data although the tabulated counts of households and population were consistent with the Housing census tabulated figures. Some tables showed inconsistencies and a list of the relevant edit specifications was drawn and incorporated in a correction programme, CONCOR to remove the inconsistencies from the tabulated data. However some tables still contained slight inaccuracies that would be too costly and time-consuming to identify and correct (CSO, 2002a). Enumeration involved a two-round procedure with the Housing Census 2000 preceding the Population Census 2000 so that a list of names and

[42] When the validation process was completed, the data files were aggregated at the country level.

addresses may be obtained to serve as a frame for the latter. However separate analysis has been carried out for each data set.

4.4 Reliability and validity of the one percent sample

For the purpose of this study, I had access to a 1% sample of the 2000 Population Census data set. The sampled households used in this study are drawn on a systematic sampling basis. This method ensures that the sample is more evenly spread across the population. There is no problem of periodicity as the systematic sampling has an equal possibility of selecting an individual irrespective of gender or any other personal characteristics. Thus, a random 1% sample has been drawn from the full population census and it is a representative sample at the national level. The 1% sample consists of 51.4% of males and 48.6% of females, of which, 20% are children (aged between zero to eleven years).

The 2000 Population Census data set satisfies the requirements necessary to derive robust returns to education estimates and it meets some of the conditions advocated by Bennell (1998). Bennell (1994), for instance, argues that RORE studies must not be subject to sample selection, that is, not rely on earnings data in the formal sector only[43], the problem of

[43] Bennell (1994) argues that the formal sector employment is a relatively small & declining percentage of the labour force in most developing countries.

omitted variables must also be addressed as the provision of formal education is one of the numerous factors affecting income determination and studies must rely on formal survey data to ensure the quality of research. Estimates generated exclusively from formal earnings in countries where the proportion of self employed people comprises a large proportion of the working population and among those with basic education are most likely to be misleading and seriously overstated. Earnings from wage employment tend to be higher than those generated from self-employment (Bennell, 1998). The data used for the current study is collected for a large, representative sample of the entire population across all economic sectors and geographical locations and is not confined to very specific locations or to those employed in the formal sector only. The Population Census 2000 is a formal survey data and includes earnings from both the formal and non-formal sectors and so does not suffer from this problem. The problem of omitted variables is, however, assessed through the use of the IV procedure in Chapter 6.

However, the 2000 Population Census data set does not provide adequate information on the socio-economic background of individuals, and it contains neither the expenditures on education nor the net income earned by the individuals from paid work. The lack of such information considerably hinders the analysis of the data set. For example, I am restricted to estimating gross returns to education rather than net (private) returns. Nevertheless, inferences about net incomes from wages only and the amount spent on education by the average household for instance, may be made from analytical reports compiled by the CSO itself for the Budget Household Survey (BHS) for 2001/02.

4.5 Descriptive statistics of some main variables

Some descriptive statistics of the main variables derived from the 1% sample which consists of 12,490 individuals, are presented in this section:

4.5.1 Age

The fact that the 2000 Population Census data provides information on each individual's age makes it possible for the researcher to construct age-earnings profiles. However before this may be done, an adult population needs to be identified. Initially, data for 6411 males and 6071 females are reported. But for the purpose of estimating returns to education in the Republic of Mauritius, the sample must be reduced to include only those who are of working age. The relevant age boundary, using the range logical function is thus restricted to between 12 and 59 years inclusive. When an individuals are 60 years old, they are entitled to the State retitrement pension and, thus, all analysis excludes those above the retirement age. The lower age limit of 12 years has been selected because the estimates of labour force, employment and unemployment published for the Republic of Mauritius refer to the population aged 12 and above[44] and this age limit of 12 applies only to estimates made prior to 2004 (CSO, 2004). There is a considerable percentage of those aged below 21 years in the sample (around 11%). However as will be seen in Chapter 5, for different analyses, I sometimes restrict the age range of the sample differently, that is, I exclude very young workers.

The reduced sample contains a total of 8906 individuals, with 4670 men and 4236 women. Around 20% of the original sample includes those below the age of 12 while 8% are above the age of 59. Thus, an adult population of working age is identified.

Next the age-earnings profiles, as illustrated in Figure 4.1, are constructed for the four levels of education including those with no schooling at all[45]. The highest earnings profile is that of those workers who successfully completed tertiary education, then followed by those who hold vocational qualifications and the lowest being for those with no schooling at all or with at most primary schooling.

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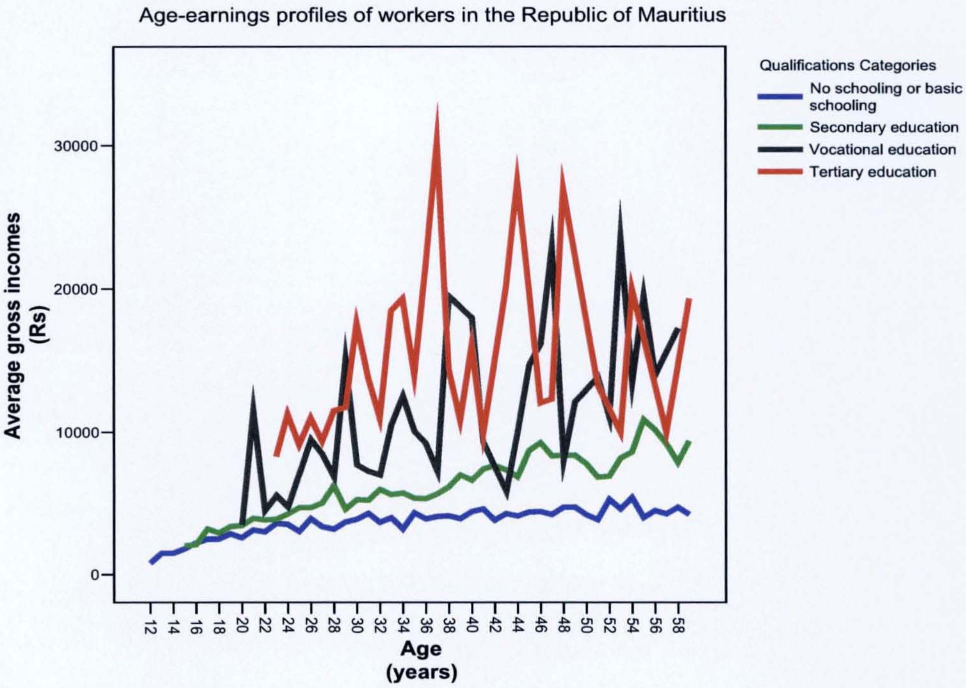
[44] Based on the recommendations of a Technical Committee set up to analyse the findings of a World Bank study on unemployment in the Republic of Mauritius, the lower age limit has been raised to 15 years as from 2004.

[45] These different levels of schooling are discussed later in this section under the 'Qualification variables' sub-heading. However, here to simplify the age profile diagram, lower secondary, upper secondary and GCSE & sixth form are aggregated under secondary education.

Figure 4.1: Age-earnings profiles for the adult population



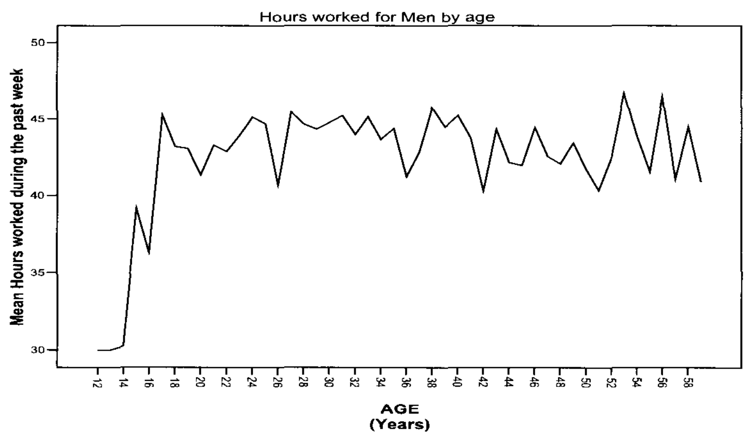
Source: Computed from 2000 Population Census data

The age earnings profiles for those with no schooling at all or at most with basic schooling are flat, implying that these individuals experience slower growth rates of earnings as they age. The age earnings profiles for tertiary and vocational education are not smooth. This may be mainly because there are few individuals at each age in each of these two groups. The total numbers of individuals in the sample with vocational and tertiary education were only 109 and 114, respectively and when these are split by age groups, there were too few individuals for each age (Appendix D). These age earnings profiles also contain cohort effects, that is, differences in wages in the estimated profiles are also caused by factors which are specific to cohorts rather than being due to the effects of age only.

4.5.2 Hours of work

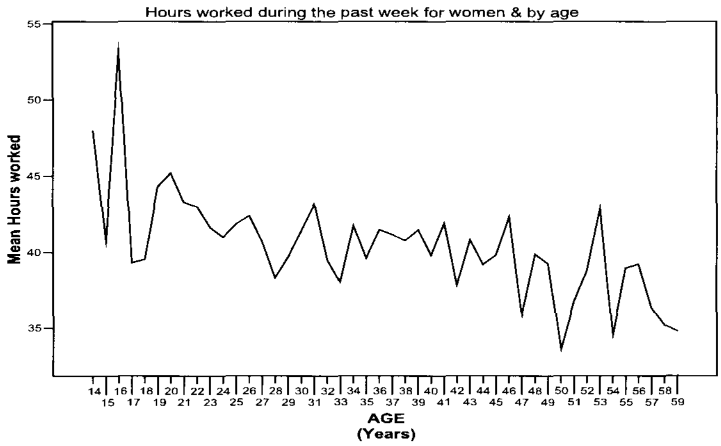
Additionally the sample is further restricted to include only those who worked during the past week of the Population Census 2000. When all the cases for which 'Hours worked during past week > 0' were selected, the sample size fell drastically from a total of 8906 to only 4464 individuals. Around 30% of the sample aged between 12 and 59 and who were in work, were women, and 66% of these had children. Figure 4.2(a) and Figure 4.2(b) show that there is considerable disparity between men and women for hours worked. Hours worked during the last week tend to be within the range of 40 and 48 for all those men above the age of 18, while the range for women tend to be wider and unlike men they show an overall downward trend as age increases.

Figure 4.2(a): Hours worked by age for men



Source: Computed from census data from CSO.

Figure 4.2(b): Hours worked by age for women



Source: Computed from census data from CSO.

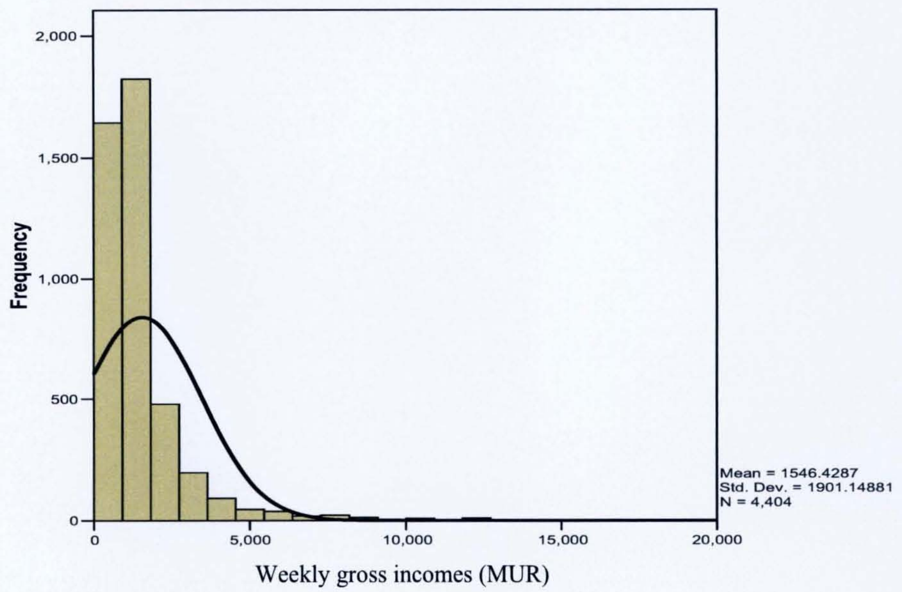
The information available for the 'hours worked during the past week' may be used to adjust for the fact that more educated workers spend relatively more time in gainful employment than the less educated. This creates greater opportunity for investing further in job skills and potentially improves the ability to earn higher wages in the future. This observed fact may be accounted for, by including a variable for the logarithm of hours worked in earnings functions (Kugler & Psacharopoulos, 1989; Psacharopoulos & Alam, 1991). However this inclusion of the 'log hours' variable may create a source of endogeneity bias as the variable 'hours worked during the past week' itself is endogenous to the model.

4.5.3 Earnings

As pointed out earlier, the 2000 Population Census data set only provides total cash income in Mauritian rupees (MUR) received from all sources for the month of June 2000 and no distinction is made between wages and other sources of income, thus, all analysis will be carried out on gross earnings. The sample is further restricted to include only those individuals whose gross incomes exceed zero, that is, only those individuals within the adult population who are in paid work are selected. The selected adult population in the paid employment sample has a total of 4404 individuals, of which 31% are women.

The original variable 'gross monthly income' is divided by 4 to adjust for the 4 weeks in the month of June 2000 when the census was carried out. The gross weekly income is computed because the Population census data provides information about the 'hours worked during the past week'. As I will use gross incomes per hour earned by the individuals in the sample, this transformation is deemed necessary. In order to examine the central tendency, dispersion and outlying values of the 'gross weekly incomes' variable, the following histogram has been produced (Figure 4.3):

Figure 4.3: The distribution of gross weekly incomes from all sources.



Source: Computed from 2000 Population Census data

As shown in Figure 4.3, the gross weekly income distribution is a skewed distribution to the right. It displays some extreme values at which gross weekly income exceeds MUR. 10000 or £185[46]. The CSO (2002c) reports an overall average weekly wage at March 2000 of only MUR 2395[47] or £45. However average weekly pay for that same period varied from MUR 1360 (£25) for labourers to MUR 6349 (£118) for medical and health officers in the public sector (CSO, 2003a)[48]. Investigations into extreme values are carried out later in this section when box plots are used.

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46 MUR refers to the Mauritian currency: rupee, where an approximation of the MUR to the British pound sterling would be: 1GBP = 54 MUR

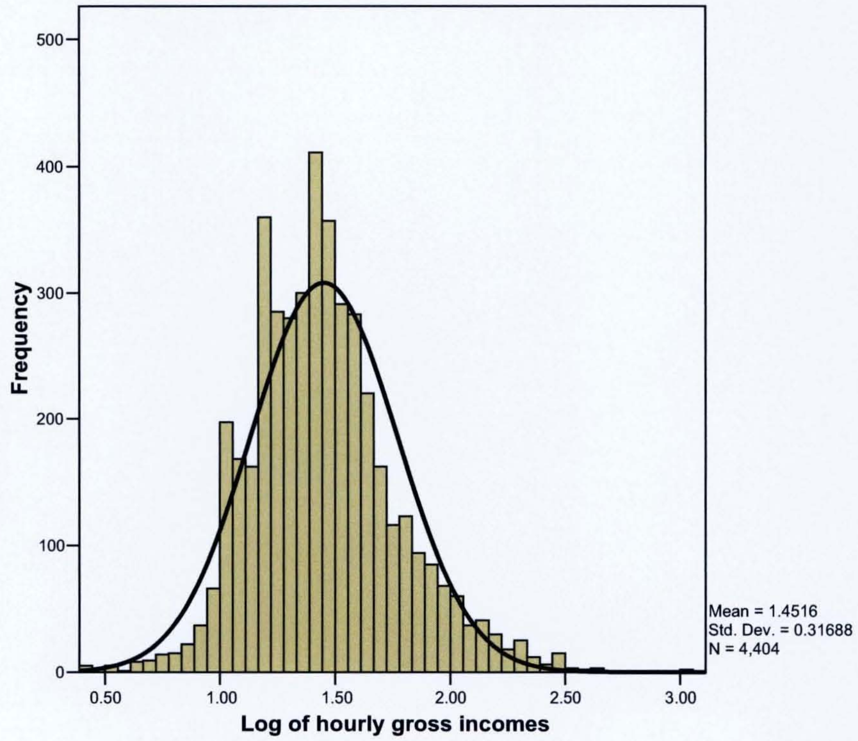
47 The population considered in estimating the size of the labour force comprises persons aged 12 years and above which matches with the adult population used for this PhD (CSO, 2002c).

48 Average monthly salaries for that same period varied from MUR 5439 (£101) for labourers to MUR 25395 (£470) for medical and health officers in the public sector

To create a distribution for the dependant variable which is closer to a normal distribution, the log of the logarithm of gross hourly income is derived from $LN\left(\frac{grossweeklyincomes}{Hoursworkedperweek}\right)$.

Consider Figure 4.4 which is supplemented by Table 4.1:

Figure 4.4: **The distribution of Log of hourly income:**



Source: Computed from 2000 Population Census data

(CSO, 2003a). These average monthly salaries have been divided into four to obtain average weekly pay.

Table 4.1: Statistics for log of hourly gross income

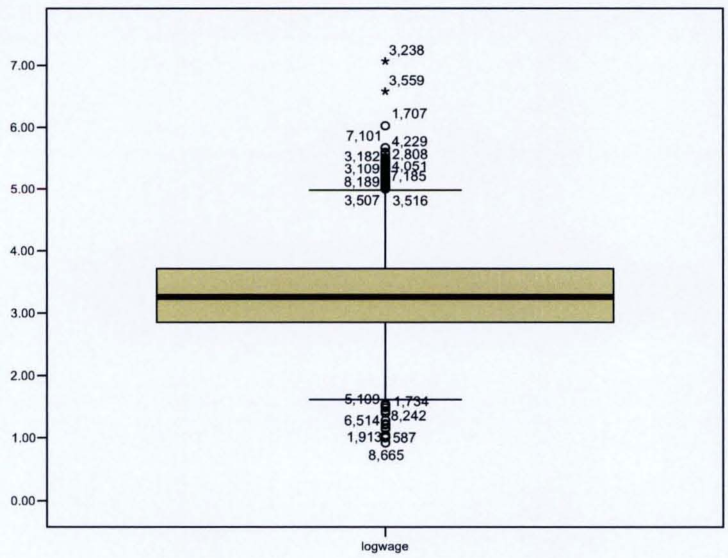
Log of hourly gross incomes

N	Valid	4404
	Missing	4502
Mean		1.4516
Std. Deviation		.31688
Skewness		.617
Std. Error of Skewness		.037
Kurtosis		1.167
Std. Error of Kurtosis		.074
Minimum		.40
Maximum		3.07
Percentiles	25	1.2396
	50	1.4243
	75	1.6198

Source: Computed from 2000 Population Census data

Some extreme values were detected earlier in this section and now a box plot of the variable 'log of gross hourly income' as labelled by 'logwage' is used to investigate these further.

Figure 4.5: Identifying outliers



Source: Computed from 2000 Population Census data

The relevant boundary for the log of gross hourly income is within 1.51 and 5.05 for the selected sample of adult population in paid employment. This range in terms of the local currency, translates into MUR 4.50 and MUR 156 per hour and the CSO (2002c) reports an average wage rate per hour of MUR 24.48 for July 2001. Moreover hourly wage rates vary across occupations, for instance, in 2002, average hourly earnings ranged from around MUR 16 for cleaning services in offices and buildings to around MUR 160 for accounting and auditing services in the private sector (CSO, 2003).

4.5.4 Qualification variables

The selected sample also contains information about the level of education. Educational attainment refers to the highest level of education completed at school by individuals or the level being attended for those still at school (CSO, 2000). Seven dummy variables are created for each highest qualification level and these are 'No schooling at all or at most primary education', 'lower secondary[49]', 'upper secondary'[50], 'GCSE &

[49] 'Lower secondary' includes all those individuals who studied between Forms 1 to 3 and at the time when they were studying, these individuals were usually within the age range of 12 to 14 years.

[50] Upper secondary includes those individuals who studied up to either Form 4 or Form 5 and these people on average, were aged between 15 and 17 when they left school. They either dropped out at the end of Form 4 or they did not pass their 'O' level examinations at the end of Form 5.

sixth form'[51], 'A level'[52], 'vocational education' and 'tertiary education'. Table 4.2 shows the number and percentage of individuals within each category.

Table 4.2: Highest qualification variables

	Qualification Levels	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no schooling or at most primary schooling	1865	43.6	43.7	43.7
	lower secondary	484	11.3	11.3	55.0
	upper secondary	773	18.1	18.1	73.1
	GCSE & sixth form	641	15.0	15.0	88.1
	A level	286	6.7	6.7	94.8
	Vocational education	109	2.6	2.6	97.3
	Tertiary education	114	2.7	2.7	100.0
	Total	4272	100.0	100.0	
Missing	System	2	.0		
Total		4274	100.0		

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius.

The category 'vocational education' includes those who undertook vocational and technical training such as secretarial and basic training in midwifery outside of normal academic schools, ranging from elementary job training to programmes leading to diplomas. These qualifications vary from the basic schooling level to programmes leading to diplomas whose level would lie above a Higher School Certificate but just below a first University Degree in the academic system (CSO, 2002b). In other words, this is a very heterogenous group.

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[51] Here the category 'GCSE & Sixth form' includes those who passed their 'O' level examinations or the equivalent of GCSE in the UK, and those who registered to do an 'A' level, however failed to complete successfully their 'A' levels.

[52] This category 'A level' includes all those who passed their 'A' level examinations.

Initially about 97% of the sample (of the original variable containing observations on vocational education) had missing values on this variable. But CSO (2002b) report that the number of people enrolling for vocational education tends to be less than 5%, thus, the mean value has been set as a zero when it is missing. Although the official statistics suggest that the percentage of people with vocational education or technical education in the selected sample is in line with the national estimates, emphasis must still be laid on the fact that some genuinely missing values have been wrongly coded as zero, but I can do nothing about this problem.

The same procedure was applied for tertiary education as 98% of the sample (original variable containing observations on tertiary education) was missing. Besides the CSO (2002b) report that enrolment in tertiary education within a sample of 24,552 household members in 2000, of whom 49.3% are males & 50.7% are females for all age groups, was less than 5%. Hence all the 'system missing' in the sample were coded as 0. Again one must bear in mind that in the process, some genuinely missing values have been incorrectly coded as zero since there is no better alternative assumption.

Tertiary education in Mauritius includes courses at first university degree level or above which normally have a minimum duration of three years' full-time studies. The minimum requirement for entry is an equivalent of an 'A' level qualification (ISCED, 1997). Those currently attending a post-secondary institution and who had not yet acquired any post-secondary degree were not included in the tertiary education variable (CSO, 2002a). In other words, students are not counted as having achieved a degree.

Earnings differentials

The main purpose of this part of the chapter is to present all the major characteristics of workers from the selection of the sample of those aged 12 to 59 years old with positive incomes. The rationale for this selection from the 1% sample of the 2000 Population Census data set, for the purpose of analysis was dealt with, earlier in Part 1. The sample used in this study, thus, consists of 4256 individual workers, for whom all relevant information is available and on which the descriptive statistics discussed in this chapter are based. Descriptive statistics of all the main variables used in this study are supplemented by test statistics (T-tests) and these are used in the following discussion of the earnings differentials by gender, economic sector and by place of residence.

4.6 Earnings differentials and observable workers' characteristics

Table 4.3 presents a breakdown of mean earnings by level of education and workers' other characteristics. The average income per month for the sample is MUR 5392 or £100, however, sharp earning differentials are observed between male and female workers with women earning, on average, 26% less than men. In other words, the ratio is about 1: 1.35 in favour of males.

Also, mean earnings in the private sector are substantially lower, with the public sector employees earning, on average, about half more than private sector employees.

Workers who reside in the rural areas earn 21% less than their counterparts in the urban areas. This may reflect the prevailing competitive market situations in rural areas. However such a statement needs further investigation which is undertaken in later sections.

There is a sharp progression of incomes by the level of education for both sexes, for instance, an individual with lower secondary education earns 11.5% more than those with basic schooling or no schooling at all and those with tertiary qualifications earn 40% more than those with 'A' levels. The earnings differential, thus, increases by the level of education. Similar findings, for instance, have been reported by Psacharopoulos & Alam (1991) for their study on education and earnings in Venuezuela and by Siphambe (1997) for a similar study in Bostwana. To test for independence between average incomes and the level of education in the current study, a chi-square test is conducted. The calculated Chi-Square is $\chi^2 = 6894.16$ and the null hypothesis of no association between the levels of education and average incomes is rejected below the 0.1% level of significance. This implies a statistically significant positive relationship between education and incomes.

However as can be deduced from Table 4.3, large standard deviations are associated with different incomes, thereby cautioning us about their use and making inferences from these. However the researcher can do nothing about this situation as the variable 'income' is usually poorly collected.

Table 4.3 Mean Monthly earnings by selected worker characteristics

Worker Characteristics	Mean Earnings (MUR)	Worker Characteristics	Mean Earnings (MUR)
Sex		*Highest Education level*	
Male	5883 (3893)	Basic schooling	3948 (2296)
Female	4335 (3589)	Lower secondary	4465 (2526)
		Upper secondary	5020 (3008)
Employment sector		GCSE	6923 (4166)
Public	8039 (3960)	Sixth form	6200 (2664)
Private	4764 (3567)	A level	7993 (4696)
		Vocational qualifications	10225 (5018)
Place of residence		Tertiary qualifications	13258 (6029)
Urban	6116 (4337)		
Rural	4853 (3377)	Overall income	5392 (3867)
		Number of observations	4259

Source: Computed from 2000 Population census data
Standard deviations in parenthesis

Table 4.4 gives some descriptive statistics of the main variables used in this study. The mean age for the sample is 36 years and on average a worker has completed 9 years of schooling. He/she works in the current firm for an average of 9 years and the number of hours worked per week is 43. Such long tenure may indicate low labour mobility across firms (Bigsten & et al, 2004). Forty four percent of the sample have no schooling or have at most primary schooling, whereas 51% have at least some secondary education. Fifty seven percent of workers are from rural areas and 19% are public sector employees. As stated before, the average income per month is MUR 5392. Compared to Bostwana (Siphambe 1997), for instance, the Republic of Mauritius has a relatively older and more schooled labour force.

Table 4.4 Mean and S.D. of selected variables in the sample

Variable	Mean	S.D.
Age	35.82	10.575
Gender (1= Woman, 0=Man)	0.32	0.465
Years of schooling	9.24	3.517
Tenure	9.38	9.429
Rural (Rural =1, Urban=0)	0.57	0.495
Public sector (1=Public, 0=Private)	0.19	0.394
Mauritian	0.98	0.149
Highest Education level:		
Basic education	0.4386	0.4963
Lower secondary	0.1106	0.3137
Upper secondary	0.1700	0.3757
GCSE	0.1073	0.3095
Sixth Form	0.0042	0.0649
A level	0.0664	0.2491
Vocational qualifications	0.0254	0.1572
Tertiary qualifications	0.0225	0.1485
Individual's income	5391.99	3866.78
Hours worked (per week)	42.87	11.612
Number of observations	4243	

Source: Computed from 2000 Population census data

4.7 Earnings differentials by gender

Table 4.5 Mean Monthly earnings by gender

Highest Education level:	Men (MUR)	Women (MUR)
Basic education	4502 (2399)	2702 (1397)
Lower secondary	4960 (2591)	3167 (1791)
Upper secondary	5691 (3073)	3184 (1839)
GCSE	7404 (4109)	5959 (4125)
Sixth form	6419 (1656)	6025 (3347)
A level	8887 (5316)	7000 (3664)
Vocational qualifications	10315 (4655)	10054 (5714)
Tertiary qualifications	13739 (6340)	12379 (5396)
Number of observations	2759	1266

Source: Computed from census data
Standard deviations in parenthesis

Table 4.5 shows that men with tertiary qualifications earn, on average, 3.1 times more than men who have at most primary schooling. The equivalent figure when comparing women with tertiary qualifications to at most primary schooling is 4.6 times. The incomes ratio between male and female employees decline as the level of education increases. It is about 1:1.67 for those with at most primary schooling and falls to about 1:1.11 for those with tertiary qualifications while the ratio is 1:1.03 for vocational qualifications. In other words the gender wage gap is larger at lower levels of education. Some studies carried out elsewhere have shown that wages for men and women who have bachelor's degrees are roughly the same and that education has a positive link in closing the wage gap (Hattiangadi, 1998; Lismoen, 2002).

Table 4.6 Mean of selected variables by gender

Variable	Males	Females	t-values (Overall)
Age	35.97	35.49	-1.384
Years of schooling	9.27	9.16	-0.966.
Tenure	10.44	7.13	-10.804
Rural (Rural =1, Urban=0)	0.59	0.54	-2.573
Public sector (1=Public, 0=Private)	0.21	0.14	-5.382
Mauritian	0.98	0.96	-4.919
Education level:			
Basic education	0.4446	0.4256	-1.164
Lower secondary	0.1173	0.0962	-2.038
Upper secondary	0.1823	0.1436	-3.129
GCSE	0.1049	0.1125	0.748
Sixth Form	0.0028	0.0074	2.178
A level	0.0512	0.0992	5.869
Vocational qualifications	0.0244	0.0074	0.574
Tertiary qualifications	0.0213	0.0252	0.787
Individual's income	5882.87	4335.39	-12.370
Hours worked (per week)	43.88	40.69	-8.415
Number of observations	2893	1350	4243

Source: Computed from 2000 Population census data

Table 4.6 presents the means of the selected variables by gender and gives the differences in means of the workers' characteristics. Both sexes are of similar ages and have similar years of schooling. Mean differences in age between sexes are statistically insignificant and the same applies for the mean differences in years of schooling between sexes. So in terms of educational attainment, males & females are similar in Mauritius which is in line with other upper- middle income countries such as Argentina & Venezuela (Psacharopoulos & Patrinos, 2002; World Bank, 2007). The distribution of education attainment for the Republic of Mauritius differs between both groups and the mean differences between sexes for all qualifications, with the exception of primary, GCSE, vocational and tertiary qualifications, are significantly different from zero, some at the 1% and others at the 5% level of significance. Marginally women more than men have, on average, at least upper secondary schooling (1% more) and 4% more have tertiary qualifications than their male counterparts,

However, the mean difference in sector of employment between sexes is significant. When workers are disaggregated by gender, the data show that the average male worker has 3 more years of experience with the same employer than his female counterpart and the mean difference in tenure between both sexes is significantly different from zero below the 0.1 % level of significance. Women earn less than men. This may be explained partly by their lower experience in their current job and by their fewer hours worked per week.

4.8 Earnings differentials by sector of employment and by gender

Table 4.7 Mean Monthly Earnings by economic sector

Highest Education level	Public sector (MUR)	Private sector (MUR)
Basic education	5872 (2659)	3720 (2138)
Lower secondary	5836 (2274)	4292 (2506)
Upper secondary	6822 (2599)	4707 (2966)
GCSE	8865 (3123)	6083 (4283)
Sixth form	6086 (1974)	6244 (2959)
A level	8041 (3900)	7958 (5224)
Vocational qualifications	9729 (4412)	10823 (5651)
Tertiary qualifications	13737 (5360)	12900 (6508)
Number of observations	722	3303

Source: Computed from census data
Standard deviations in parenthesis

When earnings are disaggregated into public and private sector employees, as illustrated in Table 4.7, a sharp progression of incomes by level of education both in the private and public sectors is revealed. In fact, the incomes of those in the public sector are consistently higher than those in the private sector at all levels of education except for those holding sixth form and vocational qualifications. Similar findings have been reported by studies carried out in developing countries elsewhere [Alam & Psacharapoulos (1991) for Venezuela, Gomez-Castellanos & Psacharapoulos (1990) for Ecuador, Siphambe (1997) for Bostwana]. It may be deduced that the public sector is in an advantageous position in recruiting employees due to the higher wages it can offer, and due to better job security and public sector wages are determined by the government. Interestingly, the public sector rewards the 'sixth form' qualification relatively less than the 'GCSE' and the 'upper secondary' qualifications. One may argue that in the case of sixth form qualification, the signaling value of education is at work. Sixth form qualification reflects the unsuccessful completion of 'A' level, hence, potentially it signals to the employer that the individual in question may be less productive relative to someone who holds 'GCSE' or 'A' level.

Further characteristics of workers, disaggregated into public and private sector employees are presented in an attempt to shed light on the consistently higher earnings of public sector employees relative to private sector workers. Thus, Table 4.8 is derived and it presents the means of selected variables by economic sector. Table 4.9 and Table 4.10 present the means of selected variables by economic sector and by gender.

Table 4.8 Mean of selected variables by economic sector for men and women

Variable	Public Sector	Private sector	t-values (All)
Age	40.63	34.67	14.831
Gender(1=Woman, 0=Man)	0.24	0.34	15.602
Years of schooling	10.94	8.83	-15.849
Tenure	16.18	7.76	24.477
Rural (Rural =1, Urban=0)	0.54	0.58	-2.082
Mauritian	1.00	0.97	4.341
Highest Education level:			
Basic education	0.2424	0.4852	-12.812
Lower secondary	0.0649	0.1214	-4.646
Upper secondary	0.1310	0.1793	-3.307
GCSE	0.1689	0.0927	6.358
Sixth Form	0.0061	0.0038	0.928
A level	0.1481	0.0471	10.557
Vocational qualifications	0.0722	0.0142	9.576
Tertiary qualifications	0.0502	0.0160	5.944
Individual's income	8038.69	4763.77	23.082
Hours worked (per week)	40.99	43.32	-5.165
No. of observations	817	3426	4243

Source: Computed from 2000 Population census data

Table 4.9 Mean of selected variables by economic sector for males only

Variable	Public Sector Males	Private Sector Males	t-values (Males)
Age	41.67	34.42	15.837
Years of schooling	10.52	8.93	11.174
Tenure	17.35	8.55	20.944
Rural (1=Rural 0=Urban)	0.57	0.59	-0.817
Mauritian	1.00	0.98	3.120
Highest Education level:			
Basic education	0.2862	0.4878	-9.094
Lower secondary	0.0772	0.1282	-3.511
Upper secondary	0.1559	0.1894	-1.917
GCSE	0.1688	0.0875	5.902
Sixth Form	0.0048	0.0022	1.113
A level	0.0981	0.0385	6.010
Vocational qualifications	0.0643	0.0136	7.335
Tertiary qualifications	0.0434	0.0153	4.313
Individual's income	7952.05	5319.86	15.558
Hours worked per week	42.30	44.31	-3.808
Number of observations	622	2271	2893

Source: Computed from 2000 Population census data

Table 4.10 Mean of selected variables by economic sector and for females only

Variable	Public Sector Females	Private Sector Females	t-values (females)
Age	37.31	35.18	2.591
Years of schooling	12.72	8.87	12.716
Tenure	12.45	6.23	10.872
Rural (Rural =1, Urban=0)	0.44	0.56	-3.155
Mauritian	0.99	0.96	2.657
Highest Education level:			
Basic education	0.1026	0.4801	-10.231
Lower secondary	0.0256	0.1081	-3.628
Upper secondary	0.0513	0.1592	-3.994
GCSE	0.1692	0.1029	2.715
Sixth Form	0.0103	0.0069	0.502
A level	0.3077	0.0640	10.983
Vocational qualifications	0.0974	0.0156	6.577
Tertiary qualifications	0.0718	0.0173	4.525
Individual's income	8315.04	3664.08	18.792
Hours worked (per week)	36.80	41.35	-5.331
No. of observations	195	1155	1350

Source: Computed from 2000 Population census data

Table 4.8, Table 4.9 and Table 4.10 shows the characteristics of the sample in the public and private sectors and gives a summary of the tests of significance of the difference between the means in these two sectors. Table 4.8 shows that the average public sector worker is 6 years older, has 2 more years of schooling, works 2 less hours per week and has been working with the same employer for 8 years more than his/her private sector counterpart. Also relative to private sector employees, a slightly lower proportion of the public sector employees are from rural areas. The differences in means for these 5 characteristics between public and private sector workers are significantly different from zero below the 0.1% level of significance, except in the case of place of residence, where the differences in means are statistically significant at 5% level.

There is also a striking disparity in the education levels of those employed in both sectors. Twenty four percent of those employed in the public sector have had only basic schooling and the equivalent figure for those in the private sector is 49%. Moreover 64% of public sector employees have had at least some secondary schooling compared to only 47% of the private sector. The differences in means for all these characteristics between the public and private sector employees (with the exception of 'sixth form') are significantly different from zero at the 0.1 % level of significance. This may be partly attributed to the higher proportion of more qualified females employed in the public sector – 73% as compared to 47% in the private sector.

Mean earnings in the public sector are substantially higher despite the fewer hours worked per week. However it must be pointed out that the public sector employees are relatively older, have higher tenure and are more qualified than their private sector employees. All differences in the means of these workers' characteristics between the two economic sectors are significantly different from zero at the 0.1% level of significance. The public sector tends to employ a higher proportion of those who are more qualified and who have successfully completed their courses, for instance, 17% have GCSE, 15% have 'A' level, 7% have vocational qualifications and 5% have tertiary qualifications whereas the private sector employees consist of 49% with at most basic qualifications, 12% with lower secondary education, 18% of those with upper secondary education but only 9% of those with GCSE, 5% of those with 'A' level, 1% with vocational qualifications and 2% with tertiary qualifications. Clearly the differences in tenure, age and education may explain some or all of the difference in wages between the sectors. I explore this issue in a multivariate analysis framework later in this thesis.

Differences between sexes become more striking when the sample is disaggregated into sectors of employment by gender. Males in the public sector are 8 years older, have 1 year more schooling, have 8 years more tenure, earn relatively more and work 2 hours less per week than males in the private sector. Generally, the differences in means for all these variables between public sector males and private sector males are significantly different from zero at the 1% level of significance. However the proportion of men employed from rural areas is similar across both sectors and the mean difference between these sectors is statistically insignificant. Again the proportion of males employed in the private sector with at most primary schooling is the highest (48%) against 47% for those with at least some secondary schooling. The reverse is true for public sector employees with the equivalent figures of 29% and 61%.

When comparing the public sector female employees with the private sector female employees, the data shows that only 10% of women employed in the public sector have at most primary schooling and 73% of female employees have at least some secondary schooling. The equivalent figures for private sector female employees are 48% and 47%. The latter work on average 4 hours more per week but earn substantially less than their counterparts in the public sector. This may be attributed to the fact that public sector female employees are on average 2 years older, have 5 more years of schooling and have 6 years more of experience with the same employer. Also relative to the public sector, a higher proportion of private sector females work in the rural areas (around 12% more).

The differences in means between these two sectors for all of these characteristics are significantly different from zero at the 1% level of significance, except for the difference in the mean ages which is significant at the 10% level.

When public sector male employees are compared with public sector female employees, men are on average 5 years older, have 1 year less schooling, 5 years more experience with the current employer and earn relatively less than women, despite the latter working 5 hours less per week. This may be attributed to the fact that women in the public sector are more qualified than their male counterparts. For instance, 73% of the public sector female employees have at least some secondary schooling and the equivalent figure is 61% for male employees. The proportion of public sector female employees who reside in rural areas is 13% lower than their male counterparts. However the sample size of public sector female employees is very small. Hence any deduction made may not provide an accurate picture of the prevailing conditions in the public sector for the female employees.

Gender differences are less acute in the private sector. The average private sector male employee is 1 year older, works 3 hours more per week and has 2 years more of experience in the current job than his female counterpart. Both sexes have similar years of schooling and the distribution of educational attainment is almost identical for both groups (which is similar to Psacharapoulos & Gomez-Castellanos, 1990 for Ecuador). However women in the private sector earn relatively less than their male counterparts.

4.9 Earnings differentials by place of residence and by gender

As already pointed out, workers who reside in urban areas earn 1.26 times more than those who reside in rural areas. Table 4.11, therefore, presents a further breakdown of selected variables by place of residence and by gender in an attempt to explain the higher mean incomes of workers who live in urban areas. Table 4.12 summarises the significance tests of differences in the means of workers' characteristics across place of residence.

Table 4.11 Means of selected variables by place of residence

Variable	Urban	Rural	t-values (All)
Age	36.29	35.46	-2.518
Gender(1=Woman, 0=Man)	0.34	0.30	-2.573
Years of schooling	10.03	8.64	-11.017
Tenure	9.44	9.34	-0.356
Public sector (1= Public, 0=Private)	0.21	0.18	-2.082
Mauritian	0.98	0.97	-1.533
Highest Education level:			
Basic education	0.3390	0.5127	11.467
Lower secondary	0.1304	0.0958	-3.567
Upper secondary	0.1701	0.1699	-0.010
GCSE	0.1222	0.0962	-2.708
Sixth Form	0.0055	0.0033	-1.108
A level	0.0886	0.0500	-5.022
Vocational qualifications	0.0352	0.0180	-3.537
Tertiary qualifications	0.0358	0.0127	-5.032
Individual's income	6115.99	4853.29	-10.679
Hours worked (per week)	43.10	42.70	-1.120
No. of observations	1810	2433	4243

Source: Computed from 2000 Population census data

Table 4.12 Means of selected variables by place of residence for men

Variable	Urban Males	Rural Males	t-values Males
Age	36.70	35.45	-3.148
Years of schooling	9.82	8.88	-7.863
Tenure	10.44	10.44	0.001
Public sector (1= Public, 0=Private)	0.22	0.21	-0.817
Mauritian	0.99	0.98	-1.292
Highest Education level:			
Basic education	0.3627	0.5023	7.531
Lower secondary	0.1389	0.1020	-3.053
Upper secondary	0.1922	0.1753	-1.163
GCSE	0.1165	0.0967	-1.712
Sixth Form	0.0025	0.0029	0.220
A level	0.0591	0.0457	-1.608
Vocational qualifications	0.0308	0.0199	-1.868
Tertiary qualifications	0.0324	0.0135	-3.492
Individual's income	6502.23	5446.48	-7.265
Hours worked (per week)	44.36	43.55	-1.832
No. of observations	1195	1698	2893

Source: Computed from 2000 Population census data

Table 4.13 Means of selected variables by place of residence for women

Variable	Urban Females	Rural Females	t-values Females
Age	35.48	35.49	0.013
Years of schooling	10.44	8.09	-11.017
Tenure	7.51	6.80	-1.690
Public sector (1= Public, 0=Private)	0.18	0.12	-3.155
Mauritian	0.97	0.96	-1.161
Highest Education level:			
Basic education	0.2927	0.5367	9.312
Lower secondary	0.1138	0.0815	-2.006
Upper secondary	0.1268	0.1576	1.607
GCSE	0.1333	0.0951	-2.217
Sixth Form	0.0114	0.0041	-1.560
A level	0.1463	0.0598	-5.353
Vocational qualifications	0.0439	0.0136	-3.412
Tertiary qualifications	0.0423	0.0109	-3.686
Individual's income	5361.09	3478.32	-9.942
Hours worked (per week)	40.65	40.73	0.126
No. of observations	615	735	1340

Source: Computed from 2000 Population census data

As Table 4.11 shows workers from urban areas are 1 year older and have 1 more year of schooling than their counterpart from rural areas. But they both have similar years of experience on the same job and similar hours of work per week. Those from rural areas earn 1.26 times less than those from urban areas which may be partly attributed to the fact that public sector jobs are mostly located in urban areas. Generally, the differences in the means for the characteristics of all workers are significantly different from zero at the 1% level of significance, except for tenure and hours worked during the week, which are insignificant.

Considering only males who reside in urban and rural areas, it is found that on average, urban males are 2 years older and earn 1.2 times more their counterparts residing in rural areas and have 1 more year of schooling, although both have similar tenure and both work similar hours per week. The differences in means for these characteristics, except for tenure, are all significantly different from zero at 1% level of significance (with that of 'hours worked during the past week' being significant at the 10% level of significance). However, it must be pointed out that the urban male employees tend to be more qualified, for example, only 36% have at most primary schooling and 57% have at least some secondary schooling, and the equivalent figures for the rural male employees are 50% and 36%, respectively. The mean differences for some of the levels of qualifications are significantly different from zero either at the 1% or 5% or again at the

10% levels of significance, with the exception of 'Sixth Form' and 'A' level for which the data do not show any significant differences for males between the two locations.

When only female employees are considered across both the urban and rural areas, the data in Table 4.13 suggest that on average, women in urban areas are of similar ages, have 2 extra years of schooling, have 1 additional year of tenure, work similar hours per week and they earn 1.5 times more than their counterparts in rural areas. Also women in the public sector live mostly in urban areas. Moreover, as shown earlier in Table 4.8, the public sector employs mostly qualified female workers. This is consistent with the findings of Siphambe (1997) for Bostwana.

Moreover, when male and female employees who reside in urban areas only are considered, the data shows that males, on average, are 2 years older, have similar years of schooling, work 3 hours more per week and have 2 extra years of experience with the same employer than their female counterparts. The latter earn 1.2 times less than male employees from urban areas although they are more qualified with 62% of women from urban areas having at least some secondary schooling out of which 15% have 'A' level whereas only 6% of their male counterparts have 'A' level. The disparity between male and female employees is more striking when only rural areas are considered. The average male worker from a rural area is of similar age, has 2 extra years of schooling, 3 more years of tenure and works 2 more hours per week than his female counterpart. Moreover, the female employees in rural areas earn 1.6 times less than rural male employees although 42% of women have at least some secondary schooling and the equivalent figure is only 36 % for men. Also the public sector employs around 1.8 times more men from rural areas than women and this may be due to the cultural constraints faced by women in rural areas such as getting married when they are still very young and thus, bearing children at young ages.

4.10 Concluding note

In the first part of this chapter, I looked at the data set that will be used to estimate social returns to education. Then, the focus shifted from assessing the reliability and validity of the 2000 Population census data to the actual variables that will be used to generate estimates of the social returns to education. A sub-sample of 4256 male and female wage earners between 12 to 59 years of age, for whom all necessary information is available, were chosen for further analysis.

The second part of this chapter describes earnings differentials by gender, by place of residence and by sector of employment. Three important points are evident from the analysis presented so far: Firstly, women tend to earn less than men despite being more qualified in most cases, which may be partly attributed to their low tenure and fewer hours of work per week. Secondly, earnings vary significantly between the public and private sectors and the disparity becomes acute when the sample is further dis-aggregated by gender, with women in the private sector earning 2.27 times less than public sector female employees despite their greater hours of work per week. Thirdly, again women from the rural areas tend to earn less than the other sub-groups of the sample dis-aggregated by place of residence and by gender, which may be partly due to their lower years of schooling and tenure. However, it should be emphasised that the fact that the sample sizes for some subgroups are small and hence inferences made from them may not be generalisable to the country as a whole.

The next chapter (Chapter 5) provides OLS estimates of social returns to education in the Republic of Mauritius and it also deals with the problem arising from the fact that these results may be subject to selectivity bias.

Chapter 5: Social Returns to Qualifications in the Republic of Mauritius, using the Conventional OLS Technique and the Heckman Selection Model.

5.0 Introduction

As discussed earlier in Chapter 2, the literature distinguishes between two rates of return: the private rate of return and the social rate of return. In Human Capital Theory the private rate of return relates to all resources invested by the private individual including the opportunity costs and direct costs and all the benefits that accrue to the individual alone. Conceptually, the social rate of return also includes the public cost of providing education, tax paid on earnings and the monetary value of all external benefits. The private return includes net wage gain for the individual, whilst the social return is generally based on gross income as the latter is a better proxy to the total effect of education on productivity.

Education confers both monetary and non-monetary benefits. The monetary returns to education are expressed in the form of higher wages or earnings in the labour market. Recent studies have attempted to measure the non-monetary benefits of education, for instance, in terms of reduced family size (through adult female education), better health, political awareness, improved child care, reduced poverty, and reduced inequality. (Duraisamy & Malathy, 1990; Schultz, 1988; McMahon, 1995). Moreover Malathy (1994) shows that women's education significantly increases the time allocated to teaching children and Angrist & Lavy (1996) report the children of better educated parents stay longer and do better in schools.

Ideally for policy decisions, a measure of the total effects of education in, monetary and non-monetary terms is desirable as the non-monetary benefits associated with education are arguably potentially large. Grossman & Kaestner (1997) for instance, report that an extra year of schooling lowers the probability of death of adults by 0.4 percentage points per year and they even estimate that the improvements brought about by education on one's own health, spouse's health and child's health are around 40% of the value of the direct effect of education on earnings. 'Despite their importance, the non-monetary benefits of education have been largely ignored in the study of rates of return' (Menon, 2003; p. 376).

The available household level data in the Republic of Mauritius are inadequate for such a comprehensive return estimation. Hence the present study, based on a sample of the 2000 Population Census data, focuses on the monetary returns to education, for those who are in wage employment for which the income data are available. Moreover the 2000 Population Census data set only provides income in rupees, before any tax deductions, received by the individual from all sources of incomes (CSO, 2002a) and currently no information is available on direct and indirect costs of education. Thus, all returns to education computed throughout this thesis are only approximations to social returns to education and they must be interpreted accordingly. In this thesis, all estimates to social returns are gross wage premiums.

Nevertheless this is the first attempt in the Mauritian context to estimate returns to education, using national level representative data. Although Psacharopoulos (1973; 1985; 1994) along with other researchers (Psacharapoulos & Hinchliffe, 1973; Psacharapoulos & Patrinos, 2002; Psacharapoulos & Mattson, 1998; Katsis et al, 1999) have estimated returns to education for many countries, the Republic of Mauritius was left out due to the lack of information about wages in the population censuses conducted prior to 2000. Consequently, the time trend in the returns to education in the Republic cannot be investigated due to lack of data[53]. In other words, it is impossible to examine how the returns to education varied over time within the country. But the purpose of this study is to use existing data to derive an approximation to social returns to education for the Republic of Mauritius, and to eventually supplement existing returns to education studies conducted elsewhere.

[53] The 2000 Population Census was the first census to have a question on income in the census questionnaire.

The 2000 Population Census data set does not separate wages from other sources of incomes before taxation, and costs of educational investments are also not available, thus, it is difficult to estimate private and social rates of returns to different qualification levels for the Republic of Mauritius. Thus, all estimates only yield social returns and should not be interpreted as private or social rates of return to education. All analyses in this chapter are based on Mincer wage equations (see Chapter 4 for methodology) and estimated using Ordinary Least Squares. The selected sample of adult population[54] contains 4256 observations, out of which 68% are male workers (Please refer to the previous chapter for a detailed description of these data). The dependent variable for all the models fitted on the sample of adult population is the logarithm of hourly gross incomes. Some of the explanatory variables include qualifications, gender, nationality, public sector and rural areas. All these explanatory variables were described in Chapter 4 and were coded as dummy variables.

Qualifications are split into seven categories but since these are dummy variables, only six of them are included: lower secondary, upper secondary, GCSE & Sixth Form (for those who passes their 'O' level exams but either did not study further or dropped out after the first year of the 'A' level course) 'A' level, vocational and tertiary education. The

[54] The adult population includes those in paid employment, between the ages of 12 to 59. This was discussed at length in Chapter 4.

base category for the qualification variables up to the tertiary level is an individual with no schooling at all or at most with primary schooling, termed as 'no schooling or basic schooling' throughout this thesis.

The other explanatory dummy variables, for instance, 'rural' takes a value of 1 if the individual resides in a rural area, the 'public sector' dummy takes a value of 1 if the individual is employed in the public sector, 'gender' takes a value of 1 if the individual is female and the 'Mauritian' dummy variable takes a value of 1 if the worker is a non-foreigner, and in all the above cases, 0 otherwise. The variable 'age' and a quadratic term in 'age' are included to test the hypothesis that earnings generally rise at a decreasing rate with age. The variable 'tenure' is included, as Human Capital Theory predicts that wages increase with tenure because the value of the marginal product of labour increases over time due to the investments in general training (Becker, 1962) or specific training (Becker, 1962; Hashimoto, 1981). The quadratic term in tenure is included to allow the impact of tenure to be non-linear, that is, increasing or decreasing with tenure.

All tables in this chapter report only the social returns to qualifications along with the constant and do not include coefficients on the other explanatory variables as these are explored in the appendix to this chapter (full tables of results are also in the appendix). All wage regressions have been carried out using White's (1984) robust estimates in STATA. This has important implications for the calculation of standard errors of the estimated coefficients. These are consistent in the presence of heteroscedastic variances. Finally all estimates derived from this conventional OLS estimation are adjusted to give estimates that are free of selectivity bias.

The rest of this chapter is organised as follows: Section 5.1 outlines the method that is initially used to estimate social returns to qualifications in this chapter. In Section 5.2 the conventional OLS estimates to qualifications for men and women combined and by gender are presented. Section 5.3 further analyses the differences in the conventional OLS estimates by sector (i.e. private or public). The relative social returns enjoyed by men and women in each of these sectors are also considered. Section 5.4 looks at conventional OLS estimates to qualifications by place of residence to test the hypothesis that social returns are lower for those employees who reside in rural areas. Section 5.5 sets out the method that is used to correct for selectivity bias. Section 5.6 presents some estimates for men and women combined, free from selectivity bias. Section 5.7 provides social returns to qualifications by rural/urban areas which have been adjusted for selectivity bias associated with choice of location. Finally Section 5.8 concludes this chapter by highlighting the main findings and also pointing out that the conventional OLS estimates are robust to correction for sample selectivity in most cases.

5.1 Traditional Mincerian approach for measuring social returns in the Republic of Mauritius

The gross returns to qualification levels for the Republic of Mauritius are initially estimated using the traditional Mincerian specification, which does not include any direct educational cost. The returns to schooling are usually obtained by analysing the proportionate effect on wages of an increment in schooling. The log wage is linearly related to the years of schooling completed with a quadratic term in the labour market experience (Mincer, 1974). A simple empirical model using the Ordinary Least Squares (OLS) techniques may be written as follows:

$$\log w_i = a + \beta_i Schooling_i + \lambda_1 Experience_i + \lambda_2 Experience_i^2 + \varepsilon_i \qquad (1)$$

Where log w_i = the log of earnings for the individual i

a = wage to an individual with no schooling, here a>0

β_i = average rate of return to schooling for the individual i, here β>0

ε_i = the normally distributed residual variance in earnings

λ_1 and λ_2 describes the growth of earnings with experience, with λ_1>0 and λ_2<0.

If an individual chooses an additional year of schooling, then his/her extra education will cause his wages ($log\, w$) to rise by the value of the coefficient 'β'. The parameter of the 'experience squared' variable captures the concavity of the observed age-earnings profiles and the negative value relates to the diminishing marginal returns to experience over time. In other words, earnings will rise due to experience but at a diminishing rate. However I do not intend to use the 'years of schooling' variable extensively, except to estimate extra returns associated with one additional year of schooling at the beginning of the analysis and while deriving IV estimates. Instead I will differentiate by type of qualification.

There is no need to assume homogenous returns to each additional year of schooling as the present study estimates the labour market value of different qualifications using information about the highest qualification acquired by each respondent in the 2000 Population Census data set. Eight educational dummies will be used to represent the eight different highest qualification levels, the base category being someone with no schooling at all or with at most primary schooling.

Consider equation (2):

$$\log w_i = a + \beta_1 LowerSecondary_i + \beta_2 UpperSecondary_i + \beta_3 GCSEsixthform_i$$
$$+ \beta_4 Alevel_i + \beta_5 vocational_i + \beta_6 tertiary_i + \lambda_1 Age_i + \lambda_2 Age_i^2 + \gamma_1 tenure_i$$
$$+ \gamma_2 tenure_i^2 + \mu Gender_i + \sigma location_i + \delta public_i + \varepsilon_i \qquad (2)$$

where β_1, β_2, β_3, β_4, β_5 and β_6 are all coefficients on dummy variables representing the different levels of qualifications acquired by individual i. Here the base category for the schooling variables (up to A level) is an individual with basic schooling or no schooling at all. All the education variables are treated as exogenous. The explanatory power of the model improves quite significantly for all groups (for men and women combined, by gender, by sector of employment & by area of residence) compared to the model with continuous years of schooling[55]. The R^2 values for all groups increase considerably, for example, the R^2 value for the whole sample rises from to 0.41 to 0.47 and that of rural residents for men and women combined rises from 0.39 to 0.43.

An individual may take different routes in the educational system and the returns to all combinations of qualifications may not be homogenous (Psacharopoulos, 1994; Robinson, 1997; Dearden et al., 2002). In the UK, for instance, Dearden et al (2002) concluded that individuals who completed their 'O' levels and then acquired vocational qualifications received the highest return to their 'O' levels as compared to the return to 'O' levels for those who went on to do their 'A' levels & a degree. They argue that although 'O' level or the CSE remain significant for those

[55] The tables of results for OLS wage estimations with the continuous years of schooling are available in Appendix A. The model which uses only the continuous years of schooling are explored in Chapter 6.

pursuing their 'A' levels and a degree, they become more relevant in determining future earnings for an individual who acquires vocational qualifications after gaining this lower level of academic qualification. However the present study cannot address the complexity of routes that Mauritians took within the education system because only the highest level of qualification achieved is recorded. Therefore the labour market value of such combinations of qualifications cannot be estimated.

Nevertheless the present study can control for many other factors that affect earnings, for instance, as illustrated in equation (2), μ, σ, and γ are co-efficients on dummy variables which take a value equal to one (1) if the individual i is a woman, resides in a rural area, and works in the public sector[56], respectively. These dummies reveal the wage premium / penalty associated with being a female employee, residing in a rural area and working in the public sector. λ_1 and λ_2 on the other hand show the rate at which age affects gross earnings. This equation estimates the social returns to each highest qualification after controlling for some factors which may explain variation in the log of gross earnings. It will be used throughout this study except for the models to be fitted on male and female employees separately (where the dummy variable 'gender' will be removed), also for the models to be fitted on rural and urban areas (where

[56] However some regressions will be estimated with and without the sector variables since some of the return to education is via choice of the economic sector. The more educated individuals may choose to be employed in the public sector, for instance, to earn more.

the dummy variable 'location' will be removed) and for the models to be fitted by sector (where the dummy variable 'public' will be removed) to generate the returns to qualifications accordingly.

Also the variables 'tenure' and 'tenure squared' or 'age' and 'age squared' will be used instead of 'experience' and 'experience squared'. Generally the variable 'experience' used in most human capital empirical work, is an estimate for potential experience which is derived by subtracting the age of the individual at the time when the census/survey was carried from the age at which he/she left schooling. This assumes that the individual spends his/her time in continuous employment after his/her graduation until retirement. Age proxies for actual work experience, which in turn proxies for general training on the job. However, extended periods of unemployment or time out of the labour market may bias this estimate, especially in the case of women who have spent time raising their children at home. The 2000 Population Census data does not provide any measure of actual experience so I cannot avoid this potential bias. Thus, instead of 'potential experience', 'tenure' will be used throughout this study. Tenure is used to proxy for firm specific training. The use of 'tenure' and 'tenure squared' variables, thus, allow one to determine the rate at which firm specific experience on the job adds to an individual's earnings and also the period beyond which tenure contributes negatively earnings.

I will estimate social returns to years of schooling and qualifications in the public and private sectors to reflect nonlinearities in returns by level of qualifications. Regressions based on the 'years of schooling' variable will also be estimated for both the private and public sectors.

Returns to education may vary, for example, by gender. Such issues may be tested by using interaction terms between each variable of interest and the education variable and of course by estimating separate regression by sector, gender etc. Models with interaction terms will be fitted on the most appropriate sub-sample to allow for heterogeneous returns to qualification levels.

However, there are several possible sources of bias associated with this conventional way of estimating returns and some of these were discussed at length in Chapter 2. One possible source of bias that was not discussed earlier is sample selection bias. All estimates which are derived from the use of the censored sample of the population who is in work may be subject to sample selection bias as these will be based on the adult population who are in paid work not the population as a whole. In the original 1% sample available for the Republic of Mauritius, only 44.7% of males and 22.4% of females are in paid work. Some of this is explained by the fact that the original sample included both young children and retired people but the sample of the adult population (that is, those aged between 12 to 59 years, inclusive) included around 44% of individuals who were not in paid work, out of which 34% were men. Those who were not working may have lower wage offers relative to those working in the sample. This is further discussed in Section 5.6. This bias may be corrected by using Heckman's (1979) technique which involves a two-step procedure. In the first step the probability that an individual will be employed is determined according to a probit regression equation which includes a series of personal characteristics as regressors. From this probit equation a selection variable, the Inverse Mills Ratio is created and inserted into the right-hand side of the earnings function. That equation is then re-estimated for those employed to yield estimates free of censoring bias. This procedure requires some factors that explain the likelihood of being in employment but that do not directly affect earnings. This chapter will hence also try to account for sample selection bias.

5.2 Conventional OLS estimates to qualification levels for both men and women combined and by gender

5.2.1 Conventional OLS estimates to qualification levels for both men and women combined

Table 5.1 Social returns for men and women combined and by gender with conventional OLS[57]

Variables	For men & women combined	Men Only	Women Only
Highest Qualifications			
Lower secondary	0.112***	0.092***	0.164***
Upper secondary	0.200***	0.178***	0.278***
GCSE and Sixth form	0.496***	0.429***	0.610***
A level	0.727***	0.624***	0.850***
Vocational	0.798***	0.696***	0.980***
Tertiary	1.208***	1.079***	1.433***
Constant	1.863***	1.892***	1.481***
R^2	0.465	0.394	0.548
No. of observations	4256	2905	1351

Source: Computed from 2000 Population Census Data, CSO, Mauritius
*** significant at 1% level

As mentioned before, all regressions in this chapter control for age, age squared, gender, place of residence, citizenship, sector of employment, tenure and tenure squared. The explanatory power of the model fitted for men and women combined (see Table 5.1) is relatively high, as it explains

[57] The model includes the following control variables: age, age squared, tenure, tenure squared, citizenship, rural areas, female and public sector. The full table of results is available in Appendix A.

47% of the variations in gross incomes for the adult population. All coefficients are highly significant and have the expected signs.

- **Research question: Which level of education yields the highest social returns for the Republic of Mauritius?**

As shown in Table 5.1, the highest social returns are reported for those who have 'Tertiary' qualifications followed by those who have 'vocational' qualifications whereas 'lower secondary education' yields the lowest social returns[58]. Wages for workers with tertiary qualifications are 121% (or 235% when the mathematical adjustment for dummy variables is made[59]) higher than that for an individual with no qualifications or with at most basic schooling. However when one considers the marginal[60] social returns from secondary schooling (i.e. completion of A level) and tertiary education (derived from Table 5.1), as shown in Table 5.2, the picture becomes clearer. Completing secondary schooling ('A' level), in the Republic of Mauritius yields the high marginal social return relative to

[58] The base category relative to each qualification is someone who does not have any schooling at most or who has at most primary schooling.
[59] The need to use the mathematical adjustment $[(e^{coefficient} - 1) \times 100]$ for dummy variables when measuring their percentage effect in semi logarithmic equations was highlighted in Chapter 2.
[60] Table 5.1 compared to Table 5.1 shows the marginal or additional gain arising from the extra level of education without adjuting for $[(e^{coefficient} - 1) \times 100]$. The second row in Table 5.1 gives the marginal social return to secondary education compared to none or primary education at most. The third row gives the equivalent figure for tertiary education compared to 'A' level, that is, the difference between social returns to tertiary education and 'A' level. This gives the extra social return that is enjoyed when an individual decides to go for higher education. The same applies when marginal social returns are computed for men and women separately. Again the differences between social returns to tertiary education and 'A' level are obtained for men and women separately from Table 5.1 and these are reported in Table 5.1.

basic schooling (106.9% when adjusted by [($e^{coefficient}$ – 1) x 100]), whilst continuing and completing tertiary education yields an extra return of 48% (or 128% with the mathematical adjustment) for an individual who chooses to study beyond 'A' level.

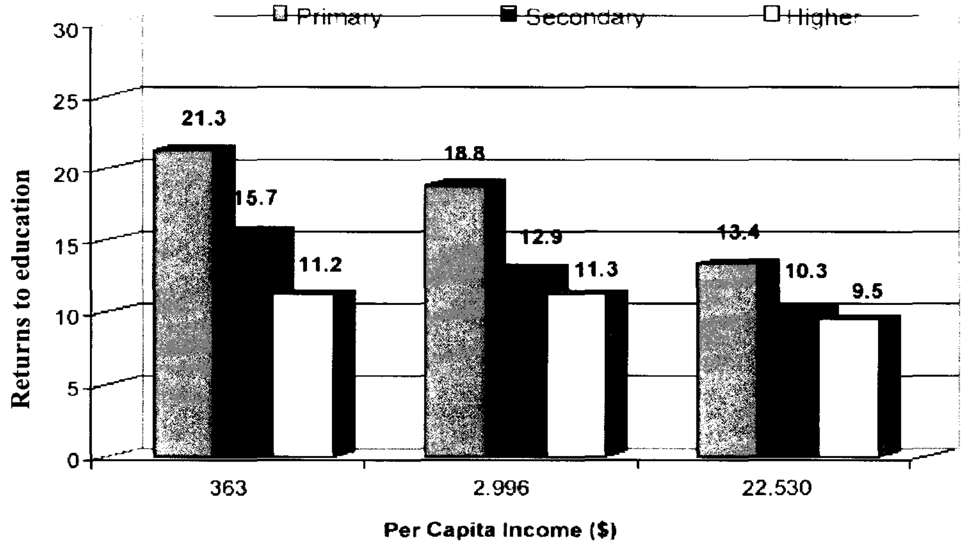
Table 5.2: Marginal social returns by type of schooling

Level of education	Social returns (%)		
	For men and women combined	Men	Women
Secondary schooling, i.e. up to 'A' level (relative to basic schooling)	73	62	85
Tertiary education (relative to 'A' level)	48	46	58

Source: Derived from Table 5.1

It must be pointed out that the GDP per capita for the Republic of Mauritius at the time of the census for 2000 was US$ 3666 (The World Bank 2007). Thus, Mauritius is in the upper-middle income group of countries and the mean GDP per capita for this group, as reported by Psacharapoulos & Patrinos (2002) is US$ 2996. Figure 5.1 shows the social returns for one year of primary, secondary and tertiary schooling from Pscharapoulos and Patrinos (2002). The returns obtained for Mauritius in this study (see Table 5.2) are higher than the world average for countries within the same income group. However this comparison is misleading because no account has been taken so far of the number of years of study taken to achieve a given level of schooling.

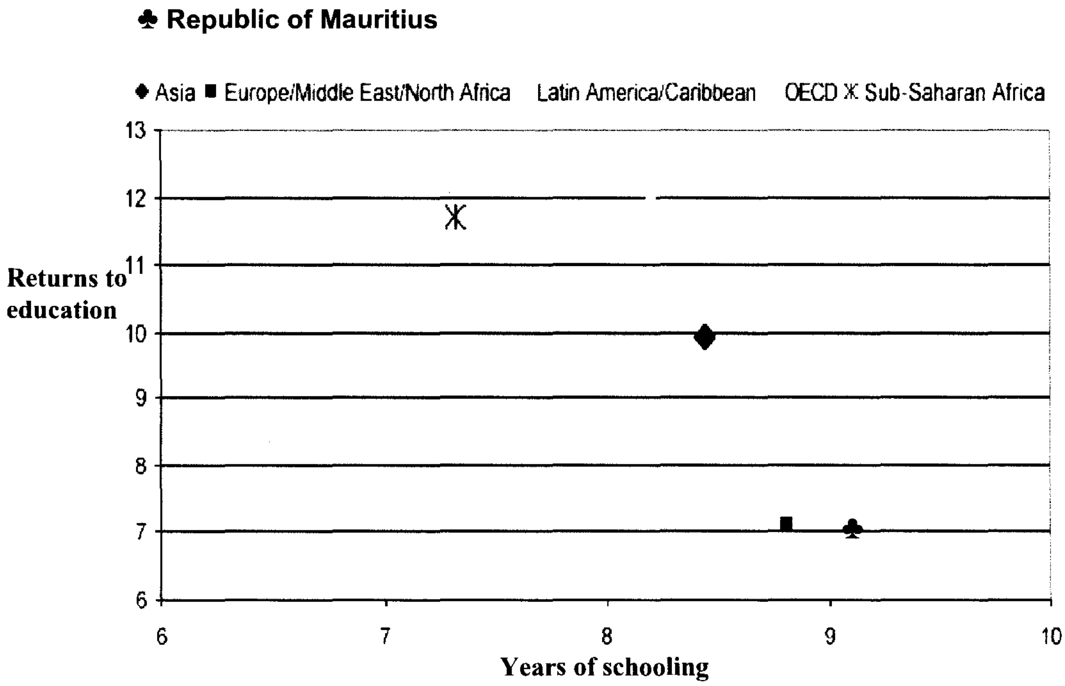
Figure 5.1: Social returns to type of schooling by income level:



Source: Psacharapoulos & Patrinos (2002):16

Psacharopoulos (1985) reports that there is a declining rate of return pattern across levels of per capita income, for instance, the highest returns to any level of education are in Africa and the lowest returns are in developed countries. He attributes this to the relative scarcity of human capital compared to physical capital within each group of countries. He further states that there is enough evidence to suggest that in developed countries the gap between average returns to physical and human capital has narrowed over time and they converge around a 10% return. Given that the Republic of Mauritius is an upper middle income country, we would expect the returns to schooling to be closer to this 10% return. I estimated the social returns to education using 'years of schooling' and I controlled for all other workers' characteristics such as age, gender, nationality, place of residence, sector of employment and tenure. The estimated social return to a year of schooling in Mauritius (excluding vocational qualifications) is 7% and it is statistically significant at the 0.1% level[61]. The mean years of schooling for men and women combined for the Republic of Mauritius, as presented in Chapter 4, is 9.2 years.

Figure 5.2: Mincerian returns and mean years of schooling



Source: Adapted from Psacharapoulos & Patrinos (2002), p.16

The position of the Republic of Mauritius (denoted by ♣) relative to other groups of countries is illustrated in Figure 5.2, suggesting that the classic pattern of falling returns to education by years of schooling is maintained. That is, countries with higher average years of schooling, have lower returns. This is consistent with most of the literature whereby the Mincerian returns and mean years of schooling are used across countries

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[61] The table of results is available in Appendix A

as illustrations of the law of diminishing returns to the formation of human capital (Psacharopoulos, 1985). However, it must be pointed out that the above comparison of social returns from other groups of countries (Psacharapoulos & Patrinos, 2002) with that of the Republic of Mauritius (in the current study) are indicative only, and are made in an attempt to assess the relative position of Mauritius to the world average.

I continue to use the qualification variables as unlike the 'years of schooling' variable, they do not assume homogenous returns to each extra year spent at school. The use of qualification variables in the wage regressions provides the labour market value of different qualifications.

5.2.2 Conventional OLS estimates of returns to qualification levels for men and women

- **Research question: Are there gender differences in the social returns to qualifications in the Republic of Mauritius?**

Table 5.1 shows the results of fitting an extended Mincerian earnings function by gender for the sample of the 2000 Population Census data. For each gender the explanatory power of the model is quite robust although it explains greater variation in the gross earnings of women (around 55% relative to around 40% for men). All coefficients in the model fitted for male and female employees separately are statistically significant at the 1% level with the expected signs, with the exception of the quadratic term in tenure for women only.

Relative to men, women consistently enjoy higher average social returns at all academic qualification levels as well as for vocational qualifications. Similar findings have been reported in most studies and such results are usually attributed to the lower foregone earnings of females relative to males (Psacharopoulos & Alam, 1991; Gomez-Castellanos & Psacharapoulos, 1990; Psacharopoulos, 1989; Psacharopoulos & Velez, 1994; Kugler & Psacharopoulos, 1989). As discussed in sub-section 5.32, the highest social returns for each sex are reported for those with tertiary qualifications, followed by vocational qualifications and 'A' level when compared to the base category. The lowest social returns for each sex are reported for lower secondary education. Vocational qualifications for men and women are significant at the 0.1% level, yielding 70% and 98%, higher returns, respectively, than what would be enjoyed by an individual with no schooling at all or with at most primary schooling. The equivalent figures when adjusted for ($e^{\text{coefficient}}$ – 1) as required for the calculation of percentage effects of dummy variables in semi logarithmic equations are 100% and 166%, respectively.

Moreover when the social returns, derived from Table 5.1, are compared by schooling type, as shown in Table 5.2, secondary schooling yields the greatest social returns (62%: men, 85%: women) as compared to tertiary education (48%: men, 58%: women). This trend is however reversed when the mathematical adjustment of ($e^{coefficient} - 1$) is done (87%: men, 134%: women for secondary schooling; 107%: men, 185%: women for tertiary education). This adjustment is required so as to avoid serious misinterpretation of dummy variables in semi logarithmic equations. Emphasis must be laid on the fact that the sample consists of only 114 individuals who have tertiary education, out of which only 37 are women.

It is important to remember that in these calculations, no account has been taken of the social costs of educational provision as such data are not available to the researcher and ideally these must be brought into the analysis to judge the profitability of educational investments.

5.3 Conventional OLS estimates to qualifications by sector and gender

In this section, the social returns to different levels of qualifications are considered by both gender and sector. The dependent variable, log of income and all the explanatory variables in the semi-logarithmic equations used in this sub-section, remain the same as those used in Section 5.3 except that the dummy variable 'public' is removed, and the dummy variable 'gender' is removed whenever social returns are estimated for men and women separately. The explanatory power of each model is quite robust and is comparable to some of the results from studies that have estimated similar earnings functions on developing countries (Kugler & Psacharapoulos, 1989; Psacharapoulos & Steire, 1988; Al-Qudsi, 1989; Duraisamy, 2002; Siphambe, 2000). Table 5.3 and Table 5.4 show the social returns estimated for the Republic of Mauritius by sector and by gender.

Table 5.3 Conventional OLS estimates of wage equation by sector and by gender: Republic of Mauritius, 2000 [62]

Variables	Private sector (For men & women combined)	Public sector (For men & women combined)	Private sector (Men only)	Public sector (Men only)	Private sector (Women only)	Public sector (Women only)
Lower secondary	0.111***	0.127***	0.093***	0.093*	0.151***	0.308**
Upper secondary	0.179***	0.327***	0.157***	0.280***	0.247***	0.634***
GCSE & Sixth form	0.463***	0.547***	0.387***	0.521***	0.580***	0.659***
A level	0.751***	0.673***	0.656***	0.642***	0.895***	0.823***
Vocational	0.856***	0.762***	0.722***	0.738***	1.114***	0.900***
Tertiary	1.241***	1.145***	1.089***	1.119***	1.525***	1.285***
Constant	1.852***	2.477***	1.814***	2.774***	1.564***	1.987***
R^2	0.363	0.475	0.286	0.450	0.395	0.565
Number of observations	3436	820	2280	625	1156	195

Source: Computed from 2000 Population Census Data, CSO, Mauritius
*** significant at 1% level, ** significant at 5% level, * significant at 10% level

[62] The model includes the following control variables: age, age squared, tenure, tenure squared, citizenship, rural areas, female and public sector. The full table of results is available in Appendix A.

Table 5.4 (Marginal) social returns by level of schooling, for each sector and by gender

Type of schooling	Social Returns (%) For men & women combined		Social Returns (%) Men		Social Returns (%) Women	
	Private sector	**Public sector**	**Private sector**	**Public sector**	**Private sector**	**Public sector**
Secondary schooling, i.e. up to 'A' level (relative to basic schooling)	75	67	66	64	90	82
Tertiary education (relative to 'A' level)	49	47	43	48	63	46

Source: Derived from Table 5.3

5.3.1 Conventional OLS estimates to qualifications by sector

- **Research question: Do social returns in the Republic of Mauritius vary between the public and private sectors?**

Referring to Table 5.3: the model has a better fit for the public sector, explaining 48% of the variations in gross earnings and the equivalent figure is 36% for the private sector. So the model explains variations in gross incomes for the public sector better than for the private sector. All coefficients for the private sector are significantly different from zero at the 0.1% level of significance. The sample fitted for public sector employees is relatively smaller, although almost all estimated explanatory coefficients are significantly different from zero, at the 1%, 5% or 10 %

level of significance except for the quadratic term in tenure[63]. Table 5.3 clearly indicates the level of significance of each qualification dummy variable.

The general pattern of rising social returns as the level of qualification shifts from low to high qualification levels, as found earlier when the Mincerian equation was estimated for men and women combined and by gender, also applies in each of the sectors. This applies to both the private and public sectors. Thus, tertiary qualifications yield the highest social returns, followed by vocational qualifications and again, the lowest social returns are reported for lower secondary education in both sectors. All coefficients on the qualification variables are statistically significant at the 1 % level and are positive.

Relative to the private sector, social returns are higher in the public sector for those with qualifications up to GCSE and Sixth Form and the reverse is true for those with higher levels of qualifications and vocational education. However this is not consistent in the case of men only. Vocational qualifications generate the second highest social returns for employees in both sectors across all three groups (for the samples of men and women combined, men only and women only).

[63] The full table of results, containing estimated coefficients for all control variables are in Appendix A

Table 5.4 focuses specifically on the marginal return of completing secondary and tertiary education. When social returns are considered within a particular sector of employment and for men and women combined, those who have completed secondary schooling up to 'A' level enjoy the highest social returns to their schooling (relative to someone with no schooling at all, or with at most basic schooling), followed by those who completed tertiary qualifications. However as found earlier, once the mathematical adjustment $[(e^{\text{coefficient}} - 1) \times 100]$ is done to calculate the percentage effect of the qualification dummy variables on gross earnings, marginal social returns for both men and women combined at the tertiary level are higher than those who end their schooling at 'A' level (private sector: tertiary education = 134% and secondary schooling = 122%; public sector: tertiary education = 118% and secondary schooling = 96%). It must be pointed out that in the sample used for this PhD, the private sector had only 164 individuals who reported 'A' level as being their highest qualification level and the equivalent figure for the public sector was 122 individuals (Appendix D).

When social returns (unadjusted for $(e^{\text{coefficient}} - 1)$) are considered across both sectors and for men and women combined in Table 5.4, those employed in the private sector (relative to those employed in the public sector) enjoy relatively higher social returns for both levels of schooling. The gap is wider for an individual who holds 'A' level (8 percentage points) as he/she gets the highest social returns if he/she is employed in the private sector and this gap widens to 16 percentage points once the mathematical adjustment is done to the coefficients of the dummy variables.

5.3.2 Conventional OLS estimates to qualifications by economic sector and by gender

Social returns by gender and sector are now considered. Before presenting the results, some discussion of the specifications by gender is needed[64].

Female: Private and Public sectors

The model specification in Table 5.3 shows social returns by gender for each sector of employment. The model has the best explanatory power for females in the public sector as it explains 57% of the variations in gross incomes, when fitted on public sector female employees, relative to those fitted for the other subgroups (private male employees, private female employees and public male employees). On the other hand, the semi-logarithmic model fitted to generate social returns for private sector female employees, consists of a relatively larger number of women and explains 40 % of the variations in gross earnings. All the coefficients generated by the model fitted on private sector female employees are significantly different from zero at the 1% level of significance, except for

[64] Please refer to Appendix A for full table of results.

tenure squared, which is insignificant. Moreover all coefficients have the expected signs for both of models fitted (private sector female employees only and public sector female employees only).

Male: Private and Public sectors

When the model is fitted onto private sector male employees it explains only 29% of the variation in the gross earnings of private sector male employees whereas when fitted onto public sector male employees it explains 45% of the variations in gross earnings. Thus, this model explains the variations in gross incomes for public sector male employees better than private sector male employees. All coefficients generated for private sector male workers only are significantly different from zero at the 1% level of significance and also all the coefficients estimated for public sector male employees' wage regression are significant at 1%, 5% or 10% level.

- **Research question: Are there differences in social returns for women across the public and private sectors in the Republic of Mauritius?**

All comparisons of social returns are made to the base category where someone has no schooling at all or at most with primary schooling. The highest social returns for women are reported for tertiary education, followed by vocational qualifications for both public and private sector employees. Once the mathematical adjustment to the coefficients of the qualification dummy variables have been done, social returns to tertiary education and vocational education for private sector female employees raise up to 360% and 205%, respectively, and the equivalent figures for public sector female employees only are 262% and 146% [65].

Those women with low levels of qualifications (i.e. lower secondary, upper secondary and GCSE & Sixth Form) can enjoy relatively higher social returns in the public sector while those with high levels of qualifications (A level, tertiary education) and vocational qualifications reap greater rewards in the private sector. The gap is widest when social returns to upper secondary education are considered across the two sectors for women. The social return, as given in Table 5.3, is 25% for private sector female employees and 63% for public sector female employees. Once the qualification dummy variables are adjusted by ($e^{coefficient}$ – 1), these returns rise up to 28% and 89%, respectively.

When the marginal returns associated with completing tertiary education are considered, as in Table 5.4, it is indeed revealed that the public/private wage gap is wide at 17 percentage points[66] and women in the private

[65] Only 22 women had tertiary education in the private sector and the sample for women with tertiary education in the public sector is even smaller (15 women only).
[66] This gap widens to 81 percentage points once the mathematical adjustment [($e^{coefficient}$ – 1) x 100] is done.

sector derive higher marginal returns from tertiary education than their counterparts in the public sector. However on average, public sector female employees who do not have any schooling at all or who have at most primary schooling, earn relatively more than their private sector counterparts, that is, the intercept term for the equation fitted for women in the public sector is higher.

- **Research question: Are there differences in social returns for men across the public and private sectors in the Republic of Mauritius?**

Men, both in the public and private sectors enjoy the highest social returns for tertiary education followed by vocational qualifications and 'A' level while the lowest social returns are reported for male employees who have lower secondary education (Table 5.3). This is similar to the previous findings in this chapter. Unlike women, men have consistently higher social returns to all qualification levels, except for 'A' level and lower secondary education in the public sector. The gap in social returns between the private and public sectors for male employees is not as severe as in the case of women. The highest gap is reported for upper secondary education and GCSE & Sixth Form (12 percentage points in each case)[67]. Social returns to lower secondary education are equalised at 9.3% for men

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[67] Once the qualification dummy variables have been adjusted by ($e^{coefficient} - 1$), the highest gap is obtained for GCSE and sixth form at 21 percentage points.

across these two sectors. On average, public sector male employees with no schooling at all or with at most primary schooling, earn relatively more than their counterparts. The intercept term for the equation fitted for men in the public sector is higher. Overall, when social returns are considered by the marginal level of schooling (Table 5.4), the marginal return from completing secondary and tertiary education are similar in both the public and private sectors for males.

- **Research question: Do women have higher social returns to qualifications relative to men in the public or private sector of the Republic of Mauritius?**

Mean wages in the public sector are higher for men than women and as mentioned in the previous chapter, the public sector is a male dominated sector, with a small number of female employees (only 24% in the public sector sub-sample are females) relative to the male employees in that sector, while women in the public sector tend to be more qualified. The difference in social returns between males and females in the public sector is greatest for upper secondary education, with women enjoying a social return of 35 percentage points in excess of what men get (or 56 percentage points when the qualification coefficients are adjusted by exp (coefficient) – 1). Social returns in the private sector are also consistently lower for men than for women. For instance, social returns to tertiary and vocational qualifications for women are 44 percentage points and 39 percentage points[68], respectively, above those for men in the same sector. It may be argued that this disparity is due to lower foregone earnings of women relative to men as reported in other studies (Psacharopoulos & Alam, 1991; Gomez-Castellanos & Psacharapoulos, 1990; Psacharopoulos & Velez, 1994; Kugler & Psacharopoulos, 1989).

5.4 Conventional OLS estimates to qualifications by rural/urban location

- **Research question: Do social returns vary across rural and urban areas in the Republic of Mauritius?**

As suggested by Schultz (1988), returns to education may be estimated by separating the sample by place of schooling or by place of birth to examine the effect of rural/urban differences in schooling availability and quality. However information on place of birth/schooling is not available in the 2000 Population Census data. Instead, the place of current residence of the individual is used to reflect the influence of rural/urban economic differences on the social returns to levels of qualifications. Hence the estimates derived for the 'rural dummy' variable must not be

[68] Once the mathematical adjustment ($e^{coefficient} - 1$) is done to the qualification coefficients, the equivalent figures rise to 162% and 98% respectively. However it must be pointed out that in the sample, only 37 women and 77 men (for both sectors combined) reported having completed their tertiary education.

interpreted as reflecting or indicating the differences due to schooling infrastructure between the rural and urban areas. Residents in urban areas may have had schooling in rural areas and vice versa. Thus, the urban/rural difference in returns will only reflect the prevailing labour market situation in those areas (Duraisamy, 2002). Furthermore, as individuals may choose to live in a particular area, location is endogenous. The evidence given here is therefore descriptive rather than causal.

Many studies only include data from individuals living in urban areas. Returns to education based on urban samples only may be biased and be of limited usefulness for educational planning and policies. However the social returns generated in Tables 5.5 and 5.6 do not suffer from this bias. Table 5.5 provides social returns to different levels of qualifications for both rural and urban areas, after controlling for all other differences. The model fitted to generate these returns is the same specification as in the models in the previous sections. Table 5.6 is based on the estimates presented in Table 5.5 but it highlights the marginal social return to completing secondary school and tertiary education.

For all locations and by gender, the explanatory power of each model is quite robust, although the model explains the lowest proportion of variation in gross earnings (35%) for those men who reside in rural areas. All models explain variation in gross earnings which are comparable to those of other studies (Psacharapoulos, 1987; Psacharapoulos & Alam, 1991; Siphambe, 1997). All the coefficients generated by each of these models in Table 5.5, have the expected signs and are significantly different from zero in almost all cases as can be confirmed from the full table of results available in the appendix.

Table 5.5 Social returns to qualifications for men and women combined, by gender and by place of residence using the conventional OLS [69]

Variables	Rural (For men & women combined)	Urban (For men & women combined)	Rural (Men only)	Urban (Men only)	Rural (Women only)	Urban (Women only)
Lower secondary	0.096***	0.143***	0.089***	0.108***	0.110**	0.222***
Upper secondary	0.173***	0.236***	0.145***	0.220***	0.256***	0.272***
GCSE & Sixthform	0.420***	0.572***	0.392***	0.468***	0.469***	0.730***
A level	0.730***	0.739***	0.650***	0.589***	0.737***	0.960***
Vocational	0.677***	0.894***	0.640***	0.750***	0.784***	1.111***
Tertiary	0.972***	1.340***	0.806***	1.235***	1.412***	1.513***
Constant	1.906***	1.678***	1.623***	2.100***	1.967***	0.689***
R^2	0.432	0.485	0.347	0.445	0.481	0.569
No. of observations	2434	1822	1699	1206	735	616

Source: Computed from 2000 Population Census Data, CSO, Mauritius
*** significant at 1% level, ** significant at 5% level, * significant at 10% level

[69] The model includes the following control variables: age, age squared, tenure, tenure squared, citizenship, rural areas, female and public sector. The full table of results is available in Appendix A.

➢ **Research question: Do rural workers have lower social returns to qualifications relative to urban workers in the Republic of Mauritius?**

With respect to Table 5.5 all the coefficients for rural and urban workers, estimated separately, are statistically significant at the 0.1% level, except for the quadratic term in tenure. After adjusting for other differences such as tenure, age, nationality, gender and economic sector, the results suggest that in the case of rural and urban areas, tertiary education exhibits the highest social returns, followed by vocational qualifications, and lower secondary education yields the lowest social returns. This is consistent with previous results. The key finding here is that urban workers enjoy consistently higher social returns than rural workers for all levels of qualifications with the widest gap for tertiary education, 37 percentage points in excess of the social returns enjoyed by rural workers. This gap is further widened to 118 percentage points when the mathematical adjustment of exp(coefficient)- 1 is done to avoid serious misinterpretation of the dummy variable estimate.[70]

Table 5.6 indicates that the urban-rural gap in the return to education is largely at tertiary level. Marginal returns for tertiary education differ dramatically across urban and rural areas for men and women combined,

[70] . However the number of individuals with tertiary education in the sample is small. There are only 77 individuals in urban areas who have a degree in urban areas and the equivalent figure for those in rural areas is 37 (Appendix D).

with the highest social marginal return of 60% (or 173% when adjusted by $e^{coefficient}$ -1) to tertiary education, obtained in urban areas (Table 5.6) compared to the 24% (or 57% when adjusted by $e^{coefficient}$ -1) earned in rural areas.

Table 5.6 Marginal Social returns by type of schooling, by gender and by place of residence

Type of schooling (relative to basic schooling)	Social returns (%) For men and women combined		Social returns (%) Men		Social returns (%) Women	
	Rural	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**
Secondary education (up to 'A' level)	73	74	65	59	74	96
Tertiary education (v/s secondary education)	24	60	16	65	68	55

Source: Derived from Table 5.5

- **Research question: Do social returns to qualifications vary by place of residence and by gender in the Republic of Mauritius?**

Irrespective of place of residence, women have consistently higher social returns for all qualification levels than men. In other words, both rural and urban labour markets offer higher social returns for women to all academic and vocational qualifications when compared to those offered to men.

For male employees, tertiary education exhibits the highest social returns, followed by vocational qualifications and 'A' level, whereas lower secondary education exhibits the lowest social returns for males residing in both the rural and urban areas. Urban male employees tend to enjoy higher social returns than rural male employees for all levels of qualifications except for 'A' level. Those men in urban areas who hold tertiary qualifications enjoyed around 43% (or 120% when adjusted by $e^{coefficient} -1$) in excess of the social returns obtained by rural males[71].

Those women who reside in urban areas have consistently higher social returns for all levels of qualifications. Again, similar to what has been reported in previous sections, social returns are highest for tertiary education, followed by vocational qualifications and 'A' level, while lower secondary education yields the lowest social returns relative to the base category. However the urban-rural gap in social returns to similar qualifications is severe in the case of women, varying between 2 to 33 percentage points[72]. The widest gap in returns is experienced by rural women with vocational qualifications, 33 percentage points below what is obtained by urban women with the same qualifications. But it must be

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[71] In the sample used for this PhD, there are only 46 men who reside in urban areas and who have tertiary education. The equivalent figure is 28 for those who reside in rural areas.

[72] When the qualification coefficients were adjusted to avoid misinterpretation of the impact of dummy variable on gross earnings, it was found that the urban-rural gap for women varied between 2 to 85 percentage points with the widest gap of 85% reported in favour for those urban women with vocational qualifications. However the number of women who have completed their degrees are very few in each of these locations (Appendix D).

pointed out that those women in rural areas who have no education or have at most primary education, have consistently higher mean wages than urban women with same level of qualification. The intercept term for rural female workers is higher than that of the urban female workers. The primary sector is mainly concentrated in rural areas and employs around 9.4% of people. Its contribution to the GDP at market prices has remained fairly constant over the years, for example at around 6.3% in 2003. Forty-six percent of the whole country is used for agriculture (CSO, 2007). It is not surprising that rural women with no education or with most primary education, have consistently higher average wages. The average daily earnings per person in sugar cane (main crop of the Republic of Mauritius) alone, for example, are at MUR 242 which is higher than the average daily earnings of MUR 218 for all sectors.

However, all the results presented so far, may be subject to sample selection bias as these are based on equations estimated from data from only those who are working and all results have thus been estimated from this censored sample of the population. The problem is that those who are not working may have lower wage offers relative to those working in the sample. This bias may be corrected by using the Heckman (1979) two-step procedure. As has already been said, in the first instance the probability that an individual will be employed is determined according to a probit regression equation which includes a series of personal characteristics as regressors. From this probit equation a selection variable, the Inverse Mills Ratio is created and inserted into the right-hand side of the earnings function. That equation is then re-estimated for those employed to yield estimates free of censoring bias. This correction is considered in the following sections:

5.5 Sample Selection Bias: empirical model & wage estimations

I will now explore the possibility of selectivity bias because in the regressions estimated above, I estimated the social returns to qualifications for those men and women only who were in paid employment and it is possible that the characteristics of employed and unemployed men and women differ. Thus I have modelled the selectivity of those in work by using a sample of both participants and non-participants for the estimation of the selection equation. Individuals are defined as a participant in the labour market if they report having worked for pay in the month preceding the census. A selection model is used to account for the bias that arises from using non-randomly selected samples, leading to specification error (Heckman 1979). Sample selection bias arises if unobservable characteristics which affect work decision are correlated with the observable characteristics which affect the process determining wages. As will be argued later in this chapter, this problem is present for some groups of individuals and is considerable when it comes to those women who reside in urban areas.

The problem of selectivity bias arises because the equation of interest (wage equation) is defined only for a subset of individuals from the overall population while ideally we want the estimated coefficients (of the wage equation) to pertain to the whole population. If the subset of individuals is non-randomly drawn from the overall population, Ordinary Least Squares regression analysis leads to inconsistent estimates (Blau & Beller, 1988; Dustmann & Rochina-Barrachina, 2001; Heckman, 1979). The dependent variable of the wage equation can only be measured when the individual participates in the labour market and wage functions estimated on selected samples do not generate coefficients for the population wage functions. In other words, if participation in the labour market is not random, the average observed wage is subject to selectivity bias and the ordinary least squares estimates of the coefficients generated by the wage regression are biased too (Reimers, 1983).

Heckman (1979) proposed a simple consistent estimation method to eliminate the specification error for the case of censored samples. The selection equation (probit function) is first estimated for the entire sample (participants and non-participants) while the main wage equation of interest is then defined solely for participants i.e. the potentially non-random sub-population (Dustmann & Rochina-Barrachina, 2001; Heckman, 1979). The selection model relates to the individual's decision to participate in the labour market which can be written as follows: $B_i{*} = \delta_0 + \sum_{j=1}^{m} \delta_j Q_{ji} + \varepsilon_i$ where B* is the net benefit of participating consisting of a set of m variables Q_j and a random term, ε_i. This is an underlying utility function which is unobserved and assumed to have a normally distributed error term. Potential earnings, $Y{*}$ are given by the Mincerian function: $Y_i{*} = \beta_0 + \sum_{j=1}^{k} \beta_j X_{ji} + u_i$ relating to a set of k variables X_j and the random term, u_i. Here actual earnings, Y_i is equal to $Y_i{*}$ if $B_i{*}>0$ and Y_i not observed if $B_i{*} \leq 0$ (Dougherty 2003). According to Heckman (1976), it can be shown that:

$$E(Y_i \mid B_i{*} > 0) = E\left(Y_i \mid \varepsilon_i > -\delta_0 - \sum_{j=1}^{m} \delta_j Q_{ji} \right) = \beta_0 + \sum_{j=1}^{k} \beta_j X_{ji} + \frac{\sigma_{u\varepsilon}}{\sigma_\varepsilon} \lambda_i$$

where $\sigma_{u\varepsilon}$ is the population covariance of u and ε, σ_ε is the standard deviation of ε and λ_i is the inverse of Mill's ratio. λ is 'a monotone decreasing function of the probability that an observation is selected into the sample' (Heckman, 1979; p. 156). It is used to test the null hypothesis of no selection bias. If a conventional wage equation does not include the selection term, it will be subject to bias if the unobserved factors in the selection equation and the wage equation are related, and $\sigma_{u\varepsilon}$ is not equal to zero. Thus, the inclusion of λ is required to control for the expected error in the wage regression given that the individual's wage is observed (Reimers, 1983). A negative coefficient on the selection term, λ, indicates a negative relationship between the error terms in the wage and selection equations. In other words, this implies that those in the working sample tended to have lower wage offers than those who are excluded (Wellington, 1993).

Thus, in this study, the technique suggested by Heckman (1980) is used to obtain consistent estimates of the coefficients of the wage equation. The inverse of the Mills' ratio, λ which predicts inclusion in the wage regression sample is estimated from a probit equation first, and then, inserted as an explanatory variable in the wage regression. In other words, for the purpose of this study, the equation which controls for selectivity bias may be written, in its general form, as follows: $\ln W_i = B' X_i + b\lambda_i + v_i$ where X is a vector of variables affecting gross incomes, λ_i is the covariance between the errors in the probit and wage equations and v_i is the disturbance term, which is normally distributed (Blau & Beller, 1998). For each group (men and women combined, by gender, by sector of employment and by location), $B'\overline{X}$ is the consistent estimate of the parameters in the wage equation for an individual with the same average characteristics as those individuals included in the wage equation. $b\lambda$ provides an estimate of the selectivity bias in the average observed wage for the group i (Blau & Beller, 1998; Reimers, 1983). The model is fitted, using the Full Maximum likelihood estimation method.

Few studies have taken potential sample selection bias into account and most of them have reported that the impact on the estimates of the regression coefficients is small (Blau & Beller, 1998; Dougherty, 2003; Heckman, 1980; Kenny et al, 1979; Wellington, 1993). In this thesis similar findings are obtained, and these will be discussed in detail. In summary however, the change in the schooling coefficient and the coefficients on different qualification variables, after adjusting for selectivity bias, is minimal.

The decision to participate in the labour market depends on several factors and the selection equation is used to model this decision. It contains all variables included in the wage equation, except for tenure, tenure squared and sector of employment[73]. This is consistent with the work of Horowitz & Schenzler (1999) who used dummy variables in the wage equation to indicate the sector, type of work, self employment and hours worked but omitting these from selection equation. In this study, the selection equation also contains some other explanatory variables that strongly

[73] These variables are excluded from the probit equation because an attempt is being made to predict inclusion in the observed wage equation and these variables suit only those who are already employed. 'Tenure', for instance, which stands for years of service with the same employer or the dummy variable 'public' which takes the value of 1if one is employed in the public sector and 0 otherwise, cannot be used in the selection equation as by definition these variables are equal to zero if someone is unemployed.

affect the chances of participating in the labour market but not the outcome under study, that is, the wage. While it is assumed that the logarithm of hourly gross earnings is a function of education variables, age, age squared and all other explanatory variables as used earlier for the OLS wage estimation, the likelihood of employment / wage being observed for men and women combined is determined by some additional factors such as the marital status of the individual, the presence of at least one child in the household[74], gender interacted with the presence of children, gender interacted with the marital status of the individual.

Having a spouse influences work propensity, therefore an individual who is married is coded 1 in the 'married' dummy. The variable 'child' refers to the presence of at least one child under the age of six in the household. It looks at the working habits of individuals with children under the age of six in the household. It is hypothesized that the presence of a child in the household influences an individual's decision to participate in the labour market. As is subsequently reported throughout the rest of this chapter, the presence of least one child increases the chances of participation for men in the labour market but, at the same time reduces the likelihood of being in employment for women. The gender, child interaction term (presence of at least one child under the age of six and gender of the individual) is used to capture the greater effect of the presence of young

[74] Marital status and the presence of at least one child in the household may impact on wages but due to a lack of alternative selection instruments, they will be used in the selection model throughout the rest of this chapter.

children in the household on the work-force participation decision of women. Age is included in both the selection and wage equations. However it serves different purposes; age in the selection equation highlights the positive relationship between labour-force participation and age while age in the wage equation serves as a proxy for work experience (Horowitz & Schenzler, 1999).

The other controls in the wage equation include, for example, age, age squared, gender and so on. The p-values of the control variables show that most of them still have a consistently statistically significant effect on the logarithm of gross hourly earnings, even when allowing for selection bias. Basically the effect of controlling for the other factors is to reduce the social returns of an additional year of schooling.

5.6 Social returns to schooling and qualifications for men and women combined and by gender, free of selectivity bias

5.6.1 The selection equation for men and women combined and by gender

In Table 5.7 I report all the coefficients from the selection equations for men and women combined and by gender. These coefficients from the model are estimated from a first stage equation where 'wfp' (workforce participation) is the dependent variable. It is a probit model.

Table 5.7 Selection equation parameter estimates for those aged 22 to 59 years

Explanatory Variables	**Coefficients** For men and women combined	**Men**	**Women**
Years of schooling	0.027***	0.0008	0.038***
Age (years)	0.098***	0.081***	0.107***
Age squared	-0.012***	-0.001***	-0.001***
Mauritians	-0.717***	-0.439*	-0.863***
Rural areas	0.039	0.176***	-0.020
Female	-0.208***	-	-
Child	0.185***	0.115	-0.150***
Gender*child	-0.280***	-	-
Marital status	0.846***	0.854***	-0.981***
Gender* marital status	-1.820***	-	-
Constant	-0.677**	-0.514	-0.960**

Source: Computed from 2000 Population Census Data, CSO, Mauritius
*** significant at 1% level, ** significant at 5% level, * significant at 10% level

<u>Men and women combined</u>:

The selection equation for the combined male and female sample reveals that all the estimated coefficients are statistically significant at the 1% level. Moreover an additional year of schooling raises the probability of employment by 4 percentage points. The coefficient on age suggests that individuals are more likely to participate in the workforce with increasing age and the coefficient of the quadratic term in age implies that the probability of labour market participation increases but at a decreasing rate. Being a citizen reduces the probability of labour market participation, as compared to a non-citizen. Evidence on whether residing in rural areas within the Republic of Mauritius affects the likelihood of being in employment is inconclusive. The coefficient on the rural dummy is insignificant. This may be attributed to the fact that all its islands[75] other than Mauritius are wholly categorised as rural areas (CSO, 2002a) or because employment rates are higher in rural areas. Additionally, being a woman reduces the probability of workforce participation by 21 percentage points, as reflected by the negative coefficient on gender. The effect of having at least one child on the likelihood of employment is 28 percentage points less for a woman than for a man. Those who are married are more likely to participate in the workforce but being married reduces a woman's chances of workforce participation to a greater extent when compared to her male counterparts.

Males or Females:

Most of the discussion in the previous paragraph continues to hold true when the sample is disaggregated by gender[76] except for the 'place of residence' dummy variable. The negative coefficient on 'place of

[75] As stated earlier in Chapter 4, the Republic of Mauritius consists of a group of islands and the island of Mauritius is divided into rural and urban areas whereas the other islands, Rodrigues, Agalega and St. Brandon are categories as rural areas (CSO, 2002a).
[76] The directions of all coefficients remain the same except that their magnitudes differ.

residence' on the last column suggests that being a woman and residing in rural areas reduce the chances of being in employment. However this result must be interpreted with caution as this coefficient is insignificant. However the equivalent coefficient for men only is positive and statistically significant at 1% level. Residing in rural areas increases their probability of being employed by 18 percentage points.

Being a woman with at least a child reduces the probability of working more than just being a woman.

Another important finding is that an additional year of schooling is likely to increase the chances of workforce participation for women by 4 percentage points while the equivalent figure is only 1.5 percentage points and is insignificant in the case of men. This implies that educated women are much more likely to participate in the labour market and education plays a greater role in explaining the participation of women than men. Similar results are obtained when the highest qualification levels (instead of the years of schooling) are plugged into the model.[77] Thus, the potential selectivity bias may be greater in the case of women, and using the conventional OLS estimate to schooling for women may be largely and negatively biased downwards. This is investigated below by looking at the schooling coefficient in the wage equation.

[77] The selection equations are available in Appendix B

5.6.2 Social returns to an additional year of schooling, corrected for selectivity bias

Initially there was some evidence of selectivity bias for the combined male and female sample and for males when the sample included young working children from the age of 12 years[78] (full tables of results are in Appendix A). However when only those individuals who are at least 22 years old are kept in the sample, selectivity bias is no longer an issue. This actually means that selectivity is important for the younger sample because those who are most able are not yet in the labour market, that is, they are still in education at that age. Insignificant selection terms mean that we can expect the conventional OLS and the Heckman selection results to be the same.

Table 5.8 shows social returns to the different qualification dummy variables entered in the wage regression after the selectivity term, λ, was included in the wage equation. Social returns are presented for both sexes combined, for males only and for females only

[78] There is, however, no evidence of selectivity for women.

Table 5.8 Wage regressions for men and women combined and by gender, adjusted for selectivity bias for those individuals aged 22 to 59 years

Explanatory Variables	Coefficients		
	For men & women combined	Men	Women
Years of schooling	0.07***	0.054***	0.0750***
Age (years)	0.0163**	0.0229***	0.0124
Age squared	-0.0001	-0.0002	-0.0001
Mauritian	0.392***	0.2339***	0.5392***
Place of residence	-0.1035***	-0.0721***	-0.1461***
Public sector	0.2879***	0.2108***	0.5193***
Gender	0.1812***	-	-
Tenure	0.0236***	0.0180***	0.0283***
Tenure squared	-0.0003***	-0.0002**	-0.0001
Constant	1.7947***	1.8739***	1.5357***
Inverse of Mill's ratio (λ)	-0.0409	-0.0742	-0.0769
X^2	2037.06***	1086.36***	1016.35***
N	5786	2884	2902

Source: Computed from 2000 Population Census Data, CSO, Mauritius
*** significant at 1% level, ** significant at 5% level

In all three equations (for men and women combined, men only & women only), adjusted for selectivity bias, the values for λ are insignificant. Given that the selection terms are insignificant in each of these cases, we expect the conventional OLS results to be similar to those of the Heckman selection results. The social return to an additional year of schooling for men and women combined (for those aged 22 to 59 years), given by the conventional OLS estimation, unadjusted for selectivity bias was 7.03%

and after adjusting for selectivity bias, the fall in social return is extremely minimal (Appendix A). The social return to an extra year of schooling for men only, as given by the conventional OLS estimation was 6.69%, and this falls slightly to 6.67% when adjusted for selectivity bias. The straightforward OLS estimation also yielded a social return of 7.3% for an additional year of schooling for women only and this figure falls to 7.1% when allowing for selectivity. All these estimates are statistically significant at 0.1% level. The difference between the conventional OLS estimates and Heckman selection results is therefore minimal.

5.6.3 Social returns to highest qualification levels for men and women combined and by gender, adjusted for sample selection bias

When individuals who are aged below 22 years are removed from the sample, there is no major selectivity bias for men and women combined and by gender, although the selection term is significant in some cases. When the selection equations and wage equations (including λ) are estimated using the qualification variables instead of the 'years of schooling' variable, the initial significant selectivity term, λ, remains negative and significant in the case of the two groups (for men and women combined and for men only) which implies that the selection issue is significant mostly for men.. Also the difference reported in the social returns for each qualification between those aged 12 to 59 years and those aged 22 to 59 is minimal. Hence I continue to use my original working sample of those aged 12 to 59 years to estimate social returns to qualifications, free of censoring bias and also because of comparability reasons[79].

Table 5.9 Wage estimations for men and women combined and by gender, adjusted for selectivity bias [80]

Educational variables:	Social Returns (after adjusting for selectivity)		
	For men and women combined	Men only	Women only
Lower secondary	0.112***	0.097***	0.164***
Upper secondary	0.199***	0.185***	0.278***
GCSE & Sixth form	0.493***	0.438***	0.610***
A level	0.719***	0.644***	0.845***
Vocational education	0.788***	0.701***	0.973***
Tertiary education	1.202***	1.10***	1.428***
Constant	2.034***	2.391***	1.510***
Inverse of Mill's ratio	-0.071**	-0.172**	-0.012
X^2	2879.03***	1575.51***	1369.10***
N	7881	3980	3901

Source: Computed from 2000 Population Census Data, CSO, Mauritius
*** significant at 1% level, ** significant at 5% level

[79] Social returns in this chapter will be compared to those deduced earlier in this chapter where the 12-59 years working sample was used.

[80] The selection equation and full table of results are available in Appendix B. The wage equation includes the following controls variables: age, age squared, tenure, tenure squared, citizenship, rural areas, female and public sector. The full table of results is available in Appendix A.

Social returns to all qualifications for each group (for men and women combined, men only & women only) are significant at the 1% level. The qualification coefficients are positive and significant in all cases. They display the expected ordering, that is, one may expect higher wages for more education (Horowitz & Schenzler, 1999). The selectivity term, λ, is negative and statistically significant at 5% level for men and women combined and for men only. This implies that the observed wage is lower than the wage offers of a randomly selected individual in the population (Siphambe, 2000; Horozwitz & Schenzler, 1999). Besides the same conclusion is obtained when results for the sample aged 22 to 59 years are analysed (Appendix B). Hence here, inclusion in the wage regression sample, is selective of those with lower values of time in alternative uses. An example of this would be in non-marketed activities. The coefficient of the inverse Mills ratio being significantly negative for men but not for women, implies that the sample mean wage is lower than the population mean wage. Thus, the conventional OLS wage regression yields biased estimates for men[81]. However this bias is very minimal when the OLS estimates for men are compared with the Heckman selection estimates. After adjusting for selectivity (as can be deduced from Table 5.1 and from Table 5.9), social returns to lower secondary, upper secondary, GCSE & Sixth Form and 'A' level fall by approximately 1 percentage point in each

[81] As will be discussed throughout the rest of this chapter, the selection effects are more relevant for men than for women. The selection terms are negative and significant in most cases for men in employment. However this unusual and surprising employment finding cannot be investigated in the case of the Republic of Mauritius due to the absence of data.

case, while social returns to tertiary education and vocational education remain the same at 101% and 70%, respectively[82]. Thus in the case of men only, the conventional OLS estimates presented earlier in Table 5.1, are slightly biased upwards. The Full maximum likelihood (FML) estimation technique yields slightly lower social returns to some qualification levels.

The last column of Table 5.9 describes the determinants of the logarithm of gross hourly earnings for women. If the assumption of random participation of women in the labour market were true, we could be satisfied with the conventional OLS wage estimations. However it is argued that such participations are unlikely to be random and women who would receive low wages may choose to stay out of the labour market, thus, causing the sample of observed wages to be biased upwards. An examination of the impact of adjusting for sample selection bias in the case of women is therefore necessary. Following the exp (coefficient) minus one transformation, differences in social returns are only observed for 'A' level (1 percentage point), vocational education (1.8 percentage points) and tertiary education (0.5 perecntage point).

We can deduce from the sample available for the Republic of Mauritius that the selectivity term is negative in the case of women, but it is

[82] When the mathematical adjustment is done to the coefficients of the qualification dummy variables, the bias remains very minimal.

insignificant and social returns through the FML estimation are similar to the ones generated by the straightforward OLS estimation procedure.

Thus, in line with many previous studies which correct for sample selectivity bias, the impact is not dramatic (Kenny et al, 1979; Heckman, 1980; Blau & Beller, 1988; Wellington, 1993; Dougherty, 2003). Thus, one may arguably continue to use the OLS social returns to qualifications for all the three groups (for men and women combined, men only and women only) for the Republic of Mauritius. Although there is evidence of selectivity bias in the case of men, minimal changes are found in the qualification coefficients when allowance is made for it.

5.7 Social returns to qualifications by place of residence, adjusted for selectivity bias

5.7.1 The selection equation by place of residence

All regressions have included an area of residence dummy variable to control for local labour market effects in terms of wages and labour force participation rates. This control has been included to account for differences between rural and urban areas, for example, differences in poverty between rural and urban areas may depend more on differences in the characteristics of the households living in those areas (Wodon, 1999).

This therefore recognises, that choice of residential location is endogenous, and may be determined by individuals' earning potential and their expected returns to education.

Thus, given these differences, the returns to education may vary between rural and urban areas and could also be due to many constraints that may create barriers to perfect mobility of labour between rural and urban areas (Duraisamy, 2002). The estimates generated earlier (conventional OLS estimates), for social returns for each of these two areas may also, be subject to censoring bias. The probit model is estimated separately for rural residents and urban residents to obtain the selection term, so that social returns to qualifications for rural and urban residents which have been adjusted for selectivity bias can be obtained. The selection model includes the same identifying variables as in the previous sections and these are marital status, the presence of at least one child in the household, an interaction term between gender and marital status and an interaction term between gender and at least one child. Marital status and the presence of at least one child have been included in the participation probit model because these are believed to be important factors when choosing between work and no work, especially for women.

Table 5.10 Selection equation parameter estimates for rural and urban residents

Explanatory Variables	Rural areas (for men & women combined)	Urban areas (for men & women combined)
Lower secondary	-0.095	0.134
Upper secondary	-0.092	0.061
GCSE & Sixth form	0.016	0.274***
A level	0.136	0.353***
Vocational education	0.236	0.561***
Tertiary education	0.099***	0.342**
Age (years)	0.277***	0.269***
Age squared	-0.003***	-0.003***
Mauritians	-0.984***	-0.913***
Gender (female =1)	-0.403***	-0.300***
Child	-0.039	0.249**
Gender*child	-0.015	-0.172
Marital status	0.961***	0.742***
Gender*marital status	-1.906***	-1.628***
Cons	-3.329***	-3.538***

Source: Computed from 2000 Population Census Data, CSO, Mauritius
*** significant at 1% level, ** significant at 5% level

As can be seen from Table 5.10, all qualification coefficients (except for tertiary qualification) are statistically insignificant for rural residents, while all qualification coefficients beyond upper secondary education are highly significant[83] for urban residents. These results imply that qualification levels do not influence the probability of being employed for

[83] Except for tertiary qualification which is significant at 5% level.

those residing in rural areas whereas post compulsory qualifications increase the likelihood of urban residents to be in employment. Thus, education seems to play a significant role in influencing the latter's decision to participate in the labour market. Age increases an individual's chances of being in paid work, but at a decreasing rate. This is true in the case of both rural and urban residents. Irrespective of area of residence, women are less likely to be in paid work. The gap in the participation rate between males and females is greatest in rural areas.

Marriage plays a highly significant role in influencing an individual's decision to work, especially for those who reside in rural areas. Having at least one child increases the probability of an urban resident being in paid work and this coefficient is significant at the 5% level while that for a rural resident is negative and statistically insignificant. Having at least one child decreases the probability of an urban woman being in employment by 17 percentage points when compared to those without a child. Similarly, being a rural married woman or an urban married woman, decreases the probability of being in paid work.

5.7.2 Wage regressions by place of residence, adjusted for sample selection bias

After the selection equations have been estimated, the values of the inverse of Mill's ratio have been plugged into the wage equations. These results are displayed in Table 5.11 [84]. Thus, here we can see that all social returns to qualifications by area of residence have been adjusted for selectivity bias.

Table 5.11 Social returns to qualifications by place of residence for men and women combined [85]

Educational variables:	Social Returns	
	Rural	Urban
Lower secondary	0.098***	0.139***
Upper secondary	0.173***	0.234***
GCSE & Sixth form	0.419***	0.565***
A level	0.726***	0.726***
Vocational education	0.671***	0.879***
Tertiary education	0.971***	1.330***
Constant	2.063***	1.867***
Inverse of Mill's ratio	-0.067	-0.075
X^2	1337.83***	1362.40***
N	4541	3340

Source: Computed from 2000 Population Census Data, CSO, Mauritius
*** significant at 1% level, ** significant at 5% level

[84] Full tables of results with control variables are available in Appendix B.

[85] The model includes the following control variables: age, age squared, tenure, tenure squared, citizenship, rural areas, female and public sector. The full table of results is available in Appendix A.

The inverses of Mill's ratio for both groups (rural and urban workers) are insignificant. Social returns to all qualifications for these groups of workers when adjusted for censoring bias are almost identical to the one generated by the conventional OLS wage regressions which did not correct for selectivity bias[86]. Social returns for the Republic of Mauritius, are consistently higher for urban residents (except for A level) than for their rural counterparts and tertiary qualification has the largest impact in urban areas (36 percentage points higher than in rural areas or 101 percentage points higher with the exp(coefficient)-1 transformation done to the qualification dummy coefficients). This is consistent with the findings of another study carried out in another developing country (Bangladesh) by Wodon (1999). He reported that higher education has the largest impact on wages in urban areas.

[86] A quick comparison between the conventional OLS estimates and those generated by the Heckman selection model can be made by looking at Table 5.5 and Table 5.11 of this chapter. However after the exp (coefficient)-1 adjustment to the qualification dummy variables is made, differences (the fall in social returns) between each of the coefficients generated by conventional OLS and the Heckman model for urban residents vary between 0.5 and 3.8 percentage points. The largest decline is registered in social returns for those who reside in urban areas and have tertiary education.

5.7.3 Social returns to qualifications by place of residence & by gender, adjusted for sample selection bias

5.7.3.1 The selection equation by place of residence & by gender

In order to investigate the issue of selectivity bias among males and females in rural and urban areas, the sample is further disaggregated by gender. Table 5.12 displays some of the results of the participation probit equations[87].

Table 5.12 Selection equation parameter estimates for rural and urban residents by gender

Explanatory Variables	Men only		Women only	
	Rural	Urban	Rural	Urban
Lower secondary	-0.144	-0.145	-0.076	0.325***
Upper secondary	-0.260***	-0.128	-0.020	0.172*
GCSE & Sixth form	-0.245**	-0.187	0.134	0.528***
A level	-0.395***	-0.451***	0.497***	0.875***
Vocational education	-0.257	-0.074	0.604**	0.934***
Tertiary education	-0.120	-0.435*	0.249	0.955***
Age (years)	0.343***	0.293***	0.236***	0.255***
Age squared	-0.004***	-0.004***	-0.003***	-0.003***
Mauritians	-0.295	-0.584	-1.293***	-0.749**
Child	-0.085	0.222*	-0.038	0.080
Marital status	0.828***	0.639***	-0.833***	-0.811***
Cons	-4.837***	-3.958***	-2.863***	-4.043***

Source: Computed from 2000 Population Census Data, CSO, Mauritius
*** significant at 1% level, ** significant at 5% level

[87] Full tables of results are in Appendix B.

All qualification coefficients play a significant role in the likelihood of being employed for urban women. These coefficients are positive and highly significant for this group of people. In the case of rural men, although upper secondary, GCSE & Sixth Form and 'A' level are statistically significant, the coefficients are negative. Thus there is little evidence to suggest that academic education increases the probability of being in employment for all the groups (except for urban women). The vocational qualification variable is positive and significant only in the case of women, and those women with vocational qualifications in urban areas are more likely to be in employment.

Age has a positive and highly significant coefficient along with the quadratic term in age being negative but highly significant (rural men, urban men, rural women and urban women). These coefficients imply that age increases at a decreasing rate the probability of an individual being in paid work. Having at least one child is only statistically significant in the case of urban men, nevertheless it suggests that urban men are more likely to be in employment if they have children. The coefficient for marital status is positive for men and negative for women. These coefficients are all significant at 1% level for all groups (rural men, urban men, rural women and urban women) which means that being married increases the likelihood of men (irrespective of area of residence) being in employment, while the reverse is true in the case for women.

5.7.3.2 Wage regressions adjusted for selectivity bias by place of residence & by gender

Table 5.13 displays results of the wage estimations, adjusted for selectivity bias when the sample is disaggregated by gender. The values of the inverse Mill's ratio remain insignificant for groups of workers except for rural males. λ is negative and significant at 5% level for those men who reside in rural areas[88]. This implies that those men who have better opportunities outside the labour market (for instance, income from landholdings) are less likely to be included in the wage sample for men within rural areas. However when social returns to qualifications for this group of individuals are compared to the ones generated by the straightforward OLS method, the impact of selectivity bias on the coefficients for qualifications is minimal[89]. After adjusting for the exp (coefficient) – 1, the qualification dummy coefficients rise by less than a percentage point except in the case of 'A' level (4 percentage points) and tertiary education (4 percentage points) when compared to the estimates

[88] As stated previously, due to lack of good raw data, this curious employment finding cannot be investigated.

[89] Please refer to Column 4 of Table 5.5 and to Column 2 of Table 5.13 for a quick comparison. There are slight increases in social returns to each qualification level, varying from 0.4 percentage point for lower secondary education to 2.3% for upper secondary education. However the sample of rural males with tertiary education is very small (Appendix D).

generated by the conventional OLS after the exp (coefficient)-1 transformation.

Table 5.13 Social returns to qualifications by place of residence and by gender [90]

Educational variables:	Men		Women	
	Rural	Urban	Rural	Urban
Lower secondary	0.093***	0.112***	0.104*	0.208***
Upper secondary	0.155**	0.222***	0.253***	0.267***
GCSE &Sixth form	0.403***	0.474***	0.477***	0.704***
A level	0.671***	0.604***	0.766***	0.915***
Vocational	0.646***	0.754***	0.821***	1.064***
Tertiary	0.825***	1.250***	1.428***	1.463***
Constant	2.215***	2.405***	1.803***	0.930***
Inverse of Mill's ratio	-0.201**	-0.110	0.085	-0.084
X^2	719.88***	817.21***	660.14***	515.32***
N	2297	1683	2244	1657

Source: Computed from 2000 Population Census Data, CSO, Mauritius
*** significant at 1% level, ** significant at 5% level, * significant at 10% level

The selectivity term is insignificant in the case of those men who reside in urban areas and a quick comparison of the social returns to qualifications generated through a straightforward OLS method, unadjusted for censoring bias (5th column in Table 5.5) and FML method, adjusted for censoring bias (3rd column in Table 5.13), indicates that the adjustment for selectivity bias causes social returns to increase only slightly. The biggest change (only one percentage point before the exp (coefficient)- 1

[90] The model includes the following control variables: age, age squared, tenure, tenure squared, citizenship, rural areas, female and public sector. The full table of results is available in Appendix A.

transformation to the qualification dummy coefficients but 3 percentage points for 'A' level and 5 percentage points for tertiary education after the exp (coefficient)- 1 transformation) is reported for those urban males with 'A' level and tertiary qualifications[91].

The rise in social returns when adjusted for censoring bias is recorded only for high levels of qualifications for those women who reside in rural areas, with an increase of 2 percentage points for 'A' level and tertiary qualifications, and an increase of 4 percentage points for those with vocational qualifications while social returns to lower and upper secondary qualifications fall by less than 1 percentage point[92] in each case. However after the exp (coefficient) – 1 adjustment is done to the qualification dummy coefficients, the largest increase is obtained for vocational education (8 percentage points) while social return to tertiary education rises by 7 percentage points and that of 'A' level rises by 6 percentage points for rural women. The inverse of Mill's ratio is positive and insignificant for rural women.

When those women who reside in urban areas are looked at, it can be deduced that although the selectivity term, λ, is negative and insignificant,

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[91] It must be pointed out that there are 49 individuals who reside in urban areas and who have tertiary education within the sample used for the purpose of this study (Appendix D).

[92] Compare column 6 of Table 5.5 in this chapter with the 5th column in Table 5.13.

social returns to all qualifications, free of censoring bias fall[93]. While the social return to lower secondary qualifications declines by 1 percentage point, that for GCSE and Sixth Form falls by 3 percentage points and those for vocational and tertiary qualifications, each decline by 5 percentage points. The biggest decline in social returns (7 percentage points), following the correction for selectivity bias, is reported for those women who reside in urban areas and who hold tertiary qualifications. The decline to all qualification levels widens when the exp (coefficient) – 1 transformation is done to the qualification dummy coefficients, for instance, social return to 'A' level fall by 11.5 percentage points, that of vocational education falls by 14 percentage points and social return to tertiary education declines by 22 percentage points. Thus social returns to qualifications generated by the straightforward Mincerian equation for women who reside in urban areas, are overestimated. It is important to bear in mind, however, that although adjusting for selectivity bias has a considerable impact on the returns for women who reside in urban areas, the coefficient on λ in the wage regression for these women are not statistically significant and the subgroups of urban women with vocational and tertiary education are very small (Appendix D). Thus, the results for urban women that include the selectivity bias correction must be interpreted with caution.

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[93] Compare the last column of Table 5.5 in this chapter and the last column in Table 5.13.

5.8 Concluding note

It is hypothesised that as nations invest more in education, one will see a fall in the social return to schooling (Psacharopoulos, 1973; 1981; 1985; 1989; 1994). For the Republic of Mauritius, one cannot yet analyse time trends in the social returns to education as this PhD is the first attempt to estimate returns to education in the Mauritian context. However the estimates derived in this chapter for the continuous schooling variable may be usefully compared with similar estimates for other countries. Figure 5.2 suggests that there is evidence of diminishing returns to schooling in the context of the Republic of Mauritius, that is, with its relatively higher average years of schooling, its social returns to education is lower compared to other countries which have, on average, fewer years of schooling.

Nevertheless the use of the years of schooling variable assumes that each extra year of schooling yields the same return to education. My analysis is not restricted to this assumption of homogeneity. I also adopt a non-linear approach by looking at different qualification levels. When social returns to the highest qualification levels (instead of the continuous schooling variable) for the Republic of Mauritius are considered, the qualification coefficients are positive and highly significant. The reference group is no schooling at all or at most primary education. All the results presented in this chapter clearly show that there is a uniform pattern of increasing social returns to rising levels of academic qualifications, for men and women combined, by gender, by sector of employment and by area of residence. Relative to the reference group, tertiary qualifications yield the highest social returns, followed by vocational qualifications, while lower secondary education generate the lowest social returns. But before any suggestions about whether further expansion of a certain level of education is justified, the public costs of these education levels must be combined with the wage benefits (Schultz, 2003). Unfortunately I did not have access to information on the public costs of schooling.

Another finding is that women enjoy consistently higher social returns relative to their male counterparts. This is in line with the existing literature. Such results are usually attributed to the lower foregone earnings of females relative to males (Psacharopoulos & Alam, 1991; Gomez-Castellanos & Psacharapoulos, 1990; Psacharopoulos, 1989; Psacharopoulos & Patrinos, 1994; Kugler & Psacharopoulos, 1989).

Another important finding is about the differences in social returns to qualifications between the private and public sectors. The public sector is an important sector in the Republic of Mauritius. It employs around 32% of individuals who are in paid jobs and the percentage of workers it employs has been stable over the last five years (CSO, 2005). My results suggest that it tends to reward low qualification levels relatively more while the reverse is true for the private sector. The rewarding of low qualification levels relatively more may be associated with the minimum wage legislation or bureaucracy. On the other hand, as the public sector offers job security, the private sector has to offer a relatively higher wage premium to attract individuals with high levels of education.

To account for urban and rural differences, wage regressions have been estimated by area of residence. Social returns to qualifications are consistently higher for urban workers than for rural workers. This may be attributed to the fact that most 'good' jobs are available in the urban areas. Primary sector[94] is mainly concentrated in rural areas with around 86% of the total number of individuals employed in that sector, residing in rural areas (CSO, 2007).

The importance of correcting for sample selection bias has been highlighted in the literature. However most studies, which have adjusted for selectivity bias, found its impact on the estimates of the regression coefficients to be small and even negligible (Blau & Beller, 1998; Kenny et al, 1979; Wellington, 1993). Findings reported in this chapter are in line with the existing literature. Selectivity bias does not appear to be a big issue for the Republic of Mauritius although there is evidence of

[94] Primary sector includes agriculture, forestry, fishing, mining and quarrying.

selectivity bias in the case of men. OLS estimates to qualifications are similar to those generated by the Heckman selection model. In most cases, where changes in social returns to different qualification levels are considerable (such as in the case of urban women), the selectivity term, λ, is statistically insignificant and the number of individuals within the relevant subgroups of qualifications are few. In the few cases where λ is significant, the magnitude of the education coefficients remain more or less the same. However it should be noted that some of the results suggest that selection employment effects are more relevant for men than for women. But it is impossible to speculate on this curious employment finding in the absence of appriopriate data.

Adjusting for selectivity bias does not alter the ranking of qualifications in terms of social returns at all. All previous trends obtained through the conventional OLS estimates are maintained, for example, compared to the reference group (that is, those who had no schooling at all or with at most primary education) individuals with tertiary education have the highest wage premium, followed by those with vocational qualifications and individuals with lower secondary qualifications have the lowest wage premium. These hold true in all cases (for men and women combined, by gender, by sector of employment and by area of residence)

However in the case of women, especially those who reside in the urban areas, adjusting for selectivity bias can have an impact of up to 7 percentage points with the biggest decline in social returns being reported for those who hold only 'A' level qualifications or 22 percentage points lower for those tertiary education when the $[(e^{coefficient} - 1) \times 100]$ adjustment is made to the qualification dummy coefficients. But again the pattern of rising social returns by qualification level is maintained and the selection term is statistically insignificant, suggesting results should be interpreted with caution.

The next chapter considers another issue arising from the use of the simple OLS technique, namely that, so far no measure has been adopted to account for ability bias, discount rates and endogeneity of schooling. Thus, Chapter 6 will explore the instrumental variables approach which can solve these problems.

Chapter 6: IV and OLS estimates to an extra year of schooling in the Republic of Mauritius

6.0 Introduction

'Years of schooling are, to a large extent, chosen by the individual' (Cruz & Moreira, 2004; p.396) and hence education must be treated as an endogenous variable. In this chapter, I focus on changes in the supply side which result in random changes to the amount of schooling that students have. These supply-side changes can be used as instrumental variables (IV) and thus, deal with the endogeneity of schooling (Card, 1999; Card, 2000; Card, 2001; Pons & Gonzalo, 2002; Levin & Plug, 1999; Harmon & Walker, 1995). Bound et al (1995) explain that the IV estimator uses at least one instrument to predict the value of the endogenous regressor and the predicted values are then used as a regressor in the wage equation. I estimate the social returns to an additional year of schooling[95] in the Republic of Mauritius using two instrumental variables, pertaining to schooling legislation: the 1993 Basic Compulsory Education Act and the 1976 free access to secondary education[96] law. However the first stage regressions reveal that the 1993 Basic Compulsory Education Act instrument is not a good predictor of schooling and thus, the basic

[95] As stated earlier in Chapter 5, the variable 'years of schooling' is up to tertiary level and excludes vocational education.

[96] The 1976 free access to secondary schooling law was actually implemented in January 1977 when the academic year started.

compulsory education instrument is dropped from subsequent analysis. The second instrument, that is, the free secondary education law, is used throughout this chapter mostly in consideration about returns for women. However this finding is in line with the national statistics, which show that the gross enrolment ratio for girls more than doubled after access to secondary schooling became free in 1977[97] (Brooks, 2000; Naugah& Poonet, Forthcoming).

It must be pointed out that IV generates estimates that are in fact Local Average Treatment Effect (LATE) estimates. The OLS estimate is the average return for the population as a whole, while the IV estimator generates the marginal return for those affected by the particular instrumental variable chosen. In this chapter, for example, the IV estimate when using the change in the minimum school leaving age provides an estimate of the return to education for those who would otherwise have dropped out of school. This implies that this particular IV estimate is largely for individuals with low schooling and high discount rates (Harmon & Walker, 1999). In such cases, the IV estimates are higher than the OLS estimates. Hence this explains the higher returns to schooling when using IV methods, as compared to OLS estimates, as will be reported in the subsequent sections of this chapter for the Republic of Mauritius. These results are in line with the majority of other results

[97] Gross enrolment ratio for girls stood at 32% in 1975 and by 2005, it had reached 71% (CSO, 2006).

reported in the literature. Also the results are based on interventions that have affected only those individuals who would have left school before the minimum period. In general therefore the instrument used only affects a particular sub-group of the population, and so the resulting IV estimate cannot be generalised to all individuals (Angrist & Imbens, 1995; Harmon & Walker, 1999; Card, 1999).

All wage equations used in this chapter have the same explanatory variables as in Chapter 5, except for the dummy qualification variables, which are replaced by the endogenous 'years of schooling' variable. The other explanatory variables include the dummy variables: 'rural' which indicates whether or not an individual lives in a rural area[98], 'public' which indicates whether or not s/he is employed within the public sector[99], 'gender' which allows us to distinguish whether the individual is a woman or not, and 'Mauritian' which states his/her nationality. Following other

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[98] Region may be highly endogenous and influenced by education itself, for instance, good qualifications may enable an individual to get a well-paid urban job. Two tables are included in Appendix A (no. 23) to show the effects of excluding location on social returns from the wage equation for the Republic of Mauritius. For a quick comparison, please refer to Appendix A no.1 and no.23. The schooling coefficient rises by 3 percentage points when the rural dummy variable is excluded from the wage equation. When social returns are allowed to vary by qualification level, all qualification coefficients rise once the rural dummy variable is excluded from the wage equation. Thus, exclusion of the region of residence from the wage equation results in higher social returns to an extra year of schooling and at each qualification level. Although individuals would have selected themselves into urban/rural areas, it is difficult to find a selection instrument which does not affect wages to explain location. Thus, in the thesis, an analysis of selection into region of residence is not undertaken but it is included in the equations and urban/rural areas are treated separately.

[99] The public sector may be endogenous as this may be the outcome of education. Qualification coefficients are reduced as can be deduced from Appendix A (no.22), by including the dummy variable 'public sector' into the wage equation for both sexes. For a quick comparison, refer to Appendix A no.1 and no.22.

studies, I also include a quadratic in 'age' to proxy for experience given the possible endogeneity of actual labour market experience (Denny & Harmon, 2000) and a quadratic term in 'tenure' to allow the impact of tenure to increase or decrease over time[100]. As the IV method is used in this chapter, a first stage schooling equation is estimated, which includes all the explanatory variables used in the earnings equation in addition to the instrumental variable dummy. Section 6.1 provides background knowledge about the problems arising from the use of the conventional OLS and highlights the need of the IV procedure.

6.1 Background

There are several possible sources of bias associated with the conventional OLS way of estimating returns and these were discussed at length in Chapter 2. These sources of bias are briefly listed below:

- Endogeneous schooling

Schooling may be endogenous and not exogenous as a result of the individual's optimal choice, causing the OLS estimates of the returns to be biased (Pons & Gonzalo, 2002). For instance, the more able individual may invest in extra schooling.

[100] It is recognised that tenure too may be endogenous. However this thesis only deals with the endogeneity of schooling.

- Omitted variable bias

In the presence of an unobservable factor such as ability that is correlated with both schooling and wages, there is a bias in OLS estimates. This bias has generally been found to be upward (Griliches & Mason, 1972; Grilliches, 1977) and the data available for the Republic of Mauritius does not provide any measure of ability, which may seriously overestimate the returns for all qualification levels.

- Measurement error in the education variables cause OLS estimates to be biased downwards (Angrist & Krueger, 2001; Dearden, 1999).

In order to solve these problems, the instrumental variable (IV) method will be used. This is based on the existence of some exogenous events that influence schooling decisions. Sub-section 6.21 explores the possibility of having some causal exogenous determinants of schooling in the case of the Republic of Mauritius. Even better, we may be able to see whether exploitation of exogenous changes in the education distribution generated from two policy interventions, yields unbiased estimates to the coefficients of the 'education' variable.

6.1.1 Introduction to the instrumental variable approach

OLS provides an estimate of the rate of return to education on average while the IV provides an estimate of the rate of return for a specific group of people whose behaviour can be manipulated by the instrument (Angrist

& Krueger, 2001). So even though OLS estimates are commonly lower than IV estimates, the size of the extra return depends on the choice of instruments. The IV approach is just a way of splitting the variance in schooling into both an exogenous and endogenous component whereby those variables which are not in the wage equation, are added into the first stage equation to explain schooling decisions. Usually instrumental variables and 'natural experiments' are used to control for things that are unobservable yet which affect both the quantity of schooling and the observed log wage. The unobserved variable is left in the error term and instead of simply estimating the model by OLS, it uses an estimation method that recognises the presence of the omitted unobserved variable. Thus, to obtain consistent estimates of the schooling coefficient the instrumental variable approach may be used for the present study. Some exogenous sources of information that are correlated with the quantity of schooling but are uncorrelated with ability such as family background (father's/mother's education) may be used. However Card (1999) argues that although family background is not a direct determinant of earnings, it may not be a valid instrument as it does not absorb the effect of omitted ability measures completely. Besides, family background measures are not available in the context of the Republic of Mauritius. Any particular variable to be used as an instrumental variable for schooling needs to be uncorrelated with ability but it must be correlated with the education variable.

This requires finding some instrument that affects schooling choices but is uncorrelated with (independent of) ability factors. A simple endogenous schooling model consists of a two-equation system:

$$\text{Ln } W_i = \alpha X_i + \beta S_i + U_i \qquad (6.1)$$

$$S_i = \gamma Z_i + V_i \qquad (6.2)$$

The log of wage (Ln W_i) is determined by a vector of exogenous variables (X_i) and years of schooling (S_i). The schooling equation is a reduced form in which Z_i is a vector of exogenous variables that influence the schooling decision so that X_i is included in Z_i and estimating equation (6.1) by OLS will yield a biased estimate of the coefficient β if S_i is not exogenous (that is, if U_i and V_i are correlated).

6.1.2 Potential instruments to estimate social returns to schooling for the Republic of Mauritius

Koop & Tobias (2004) argue that cognitive ability is strongly correlated with the quantity of schooling attained and is also correlated with observed earnings. Thus, failure to account for ability, results in an upward bias in the reported ordinary least square (OLS) estimates of the returns to education. There are many ways to deal with this problem of a biased omitted variable, for example, by using data on identical twins or siblings to difference out the unobserved ability or by simply including ability test scores in the wage regressions. Thus, if there are measures of ability, this problem may be solved. However I cannot use measures of ability to solve the ability bias problem while estimating the economic returns to education for the Republic of Mauritius. Data on the measures of ability are not available in the 2000 Population Census data set. Hence the need for IV.

As reported by Card (2000), many studies focus on the supply-side features of the education system as a source of potential instruments, for instance, changes to the minimum school leaving age, changes to tuition costs and the geographic proximity of schooling. For the Republic of Mauritius, I use a number of natural experiments arising from the changes in the education system.

There are two instruments that will be used for the present study. Firstly, secondary education became free at all levels in the Republic of Mauritius in 1976 and secondly, basic compulsory education was introduced in 1993[101] up to the age of twelve (inclusive). It is possible to build a set of variables based on the individual's age to reflect changes in the legislation relating to schooling, such as the provision of free secondary education and the introduction of the minimum school leaving age of 12 years for primary school pupils. The individual may or may not have studied under the new system in 1977 and subsequent years, and the individual may or

[101] The academic year starts in January for primary and secondary schooling.

may not have been affected by the new minimum school leaving age. Inclusion of dummy variables based on the age of the individual can record these exogenous changes.

Both the 1976 free secondary education policy and the 1993 compulsory primary education up to the age of 12 will be used as instruments for schooling while computing the marginal returns to education in Mauritius to correct for ability bias and the endogeneity problem. Compulsory schooling, for instance, select at random individuals who ordinarily would not be schooled and force them into schooling. These instruments are suitable as they are correlated to the schooling decision but do not directly affect earnings outcomes. However the results thus obtained can lead to large inconsistencies if there is a weak correlation between the minimum school leaving age and the years of schooling. This is explored in the subsection 6.1.3

6.1.3 Quality, validity and relevance of instruments

Before any variable is used as an instrument, it must satisfy the conditions listed below:

- Instrumental quality

  Bound et al (1995) argue that a strong correlation between schooling and the instruments is required and the addition of the identifying variables to the reduced form must improve the R-squared value of that equation.

- Instrumental validity

Instruments must be orthogonal, or independent of, the error term of the wage equation (E [Z_i, u_i] = 0). As argued by Pons & Gonzalo (2002) this may be tested when the Sargan mis-specification test is implemented. Under the null hypothesis of valid instruments, the Sargan statistics are 'asymptotically distributed as a chi-squared with degrees of freedom equal to the number of over-identifying restrictions' (Pons & Gonzalo, 2002; p.751). If the Sargan statistic is significantly larger than it would be under the null hypothesis, then either the model is incorrectly specified or some of the instruments are invalid. However in this chapter, all the equations[102] that are estimated (through the IV procedure) are exactly identified.

- Instrumental Relevance

Levin & Plug (1999) argue that it is necessary to ask ourselves whether or not engaging in 'corrective' procedures for potential endogeneity of schooling is necessary. This may be done by testing the null hypothesis that the OLS estimate is consistent where there is no difference between the estimates generated for β through the OLS and IV: $\beta_{OLS}=\beta_{IV}$.

[102] These refer to all IV models which include only one instrument. The model that includes both instruments is estimated only for both sexes and the instruments are valid as the Sargan test has a coefficient of 0.42 which is insignificant, suggesting that the instruments do not have any direct influence on earnings.

The Durwin-Wu-Hausman test for the endogeneity of schooling can be done and if it is significant the null hypothesis is rejected (Pons & Gonzalo, 2002). But before this test may be carried out, we should have ensured that our instruments are valid through the Sargan test.

Thus, as stated in most studies, while choosing the vector of instruments, one must be very cautious with respect to the quality and validity of these instruments (Bound et al, 1995; Card, 2000; Cruz & Moreira, 2002). Instrumental variable quality, as already explained, refers to the strong correlation between the instruments and schooling (Bound et al, 1995), so the instrument chosen must actually predict the level of schooling acquired by the individual student. This technically means that the instruments must be significant in the first stage of the IV estimation. To check this, F-tests on the excluded instrumental variables are performed. The instrumental variables must improve the R^2 value of the first stage equation (Pons & Gonzalo 2002; Harmon & Walker, 1999). Bound et al (1995) argue that the partial R^2 and the F statistics on the excluded variable(s) in the first stage regression must be routinely reported as these are rough guides to the quality of IV estimates. Thus, the F- statistic on the excluded instruments in the first stage schooling equation is computed, as is the partial R^2 value obtained from regressing schooling against the instrument(s), having partialled out common exogenous regressors. These statistics are reported throughout this chapter, to guard against the hazards of conducting inference with instruments that are weakly correlated with schooling (Bound et al, 1995).

However we cannot rely on statistical tests to check directly the validity of the assumption that the explanatory variables and the disturbance term are uncorrelated. One must be careful while selecting instruments especially in the context of the Republic of Mauritius where instruments are not readily and widely available. The decision to use the IV estimator is made on the basis of what theory might tell us or on prior information, suggesting variables which would be good instruments, for instance, supply side policies such as the change in compulsory schooling law (Harmon & Walker, 1995) and the free schooling policy (Denny & Harmon, 2000) are argued to be truly exogenous and therefore, good instruments, while family backgrounds are not reported as being good instruments (Card, 1999; Conneely & Uusitalo, 1999). Family background has been used as an instrumental variable (Levin & Plug, 1988; Denny & Harmon, 2000; Conneely & Uusitalo, 1999). Certainly family background influences schooling but due to inter-generational effects, it may also be correlated with ability and other unobserved characteristics. It may not be a valid instrument even though it has no direct effect on earnings (Card, 1999; Conneely & Uusitalo, 1999). Thus, recent studies have focused on other supply side sources of identifying variables such as education reforms (Patrinos & Sakellariou, 2004).

Thus, both instruments (the 1976 Free Education Act and the 1993 Basic Compulsory Education Act) that the researcher intends to use for the current study can be supported theoretically for not having a direct impact on earnings.

6.2 Legislation relating to schooling in the Republic of Mauritius

Following some recent studies (Harmon & Walker, 1995; Harmon & Walker 1999; Harmon et al, 2000; Pons & Gonzalo, 2002) which have used changes in education law as an instrumental variable, I have estimated the effect of education on earnings. I argue that the 1993 basic compulsory education law and the 1976 free access to secondary schooling law introduced an exogenous source of variation in educational attainment and had no direct impact on earnings. These laws have been incorporated into the model through the use of dummy variables. A dummy variable has been created for each instrument.

For an instrumental variable to be valid, the instrument must affect schooling but not be correlated with unobserved characteristics that directly influence earnings, such as ability[103].

[103] Card (2000) argues that people with a higher return to schooling will have an incentive to acquire more schooling and in a cross-sectional regression of wages on schooling, as is the case for this thesis, the OLS estimates will yield an upward biased estimate of the average marginal return to schooling.

6.2.1 The 1993 Basic Compulsory Education Act as an instrument

One of the instruments that is used for the IV procedure in this thesis is the 1993 basic compulsory schooling law, which made education at the primary level compulsory up to the age of 12. However if, before the age of 12, the child has passed his/her end of primary schooling examinations (Certificate for Primary Schooling (CPE) which is taken at the end of grade 6), he/she may leave the primary school cycle[104]. This law was introduced to deal with the problem of high drop-out rates within the primary school cycle as discussed in Chapter 3 (which is about the education system in the Republic of Mauritius). Drop-out rates within the primary schooling cycle fell from 5.5% in 1993 to 0.8% by 2003, that is, ten years after the introduction of the law[105]. The introduction of the basic compulsory schooling law has been incorporated into the IV model in this chapter through the use of a dummy variable, 'msl'. The dummy variable 'msl' captures the effects of the 1993 basic compulsory schooling law on the individuals within the sample. It takes a value of 1 to denote each individual who was affected by this law and takes a value of 0 otherwise.

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[104] The academic year for primary and secondary schooling starts in January in the Republic of Mauritius. Thus, the law states that unless a child turns 13 years on the 1st of January, he/she is allowed to repeat grade 6 if he/ she failed to pass during the first attempt. This law applies to all children enrolled in all government primary schools and aided primary schools.

[105] Data on drop-out rates for the Republic of Mauritius were collected at the Statistics Department of the Ministry of Education, IVTB Building, Phoenix.

It is built based on the individual's age. All individuals in the sample who were aged 19 years and below at the time of the census, were affected by the introduction of the basic compulsory education law[106].

Figure 6.1[107] displays the effect of the 1993 basic compulsory schooling law on an individual's highest schooling attainment, for three years prior to and three years after the implementation of the law. As pointed out earlier in Chapter 3, promotion within the primary school cycle, that is, up to grade 6 (year 7 in Figure 6.1) is automatic, however, promotion to grade 7 (year 8 in Figure 6.1) requires a pass at CPE, that is, at the end of primary schooling (grade 6) national examinations are held. Figure 6.1 clearly shows that the 1993 basic compulsory education law did predict the schooling of individuals and there was a high percentage of individuals who left school immediately at the end of the 7th year spent at school (they dropped out of the education system at the end of grade 6) after the

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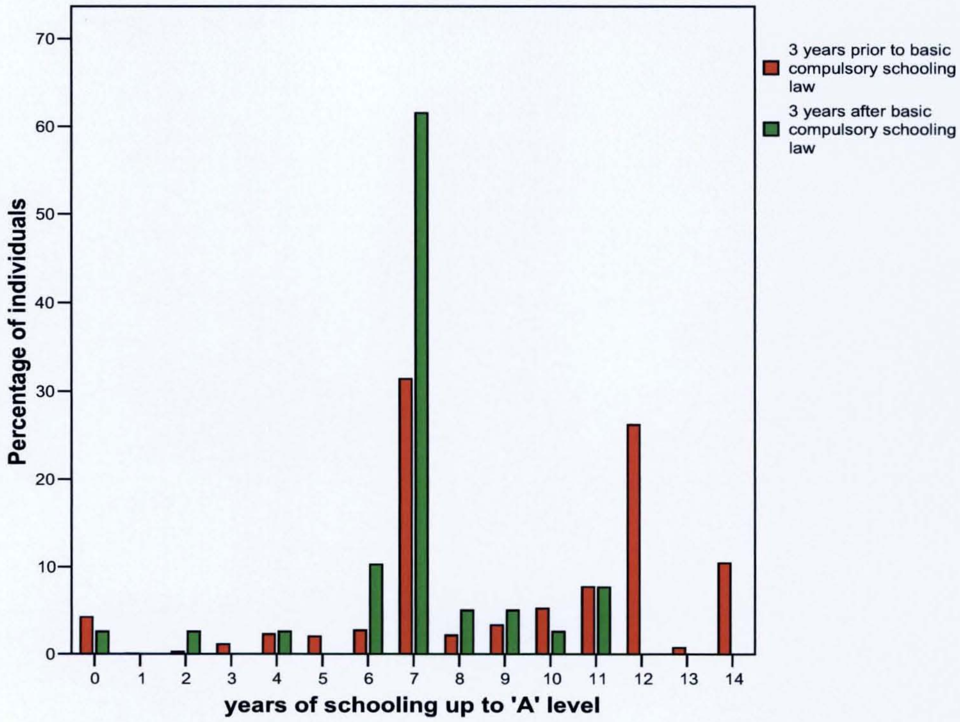
[106] The law made free primary education compulsory up to the age of 12. But since government primary schools and aided primary schools do not enrol students who are above 12 years old, the upper age limit for benefiting from free primary schooling is restricted to 12 years. Thus, for an individual to have benefited from this law, s/he should have been within the age range of 0 to 12 years in 1993 and at the time of the 2000 Population Census, s/he should have turned at most 19 years old.

[107] The working sample that has been used throughout this thesis includes 4256 individuals, aged between 12 and 59 years, for whom all necessary information is available. To draw Figure 6.1, this sample was split into two subsets after allowing for a gap of three years prior to and after the introduction of this law. This was done so that a visual description of the effect of the 1993 Basic Compulsory Schooling Act on educational attainment can be obtained. The first subset includes only those individuals who were not affected by the introduction of this compulsory schooling law, that is, those born in 1990 and prior to 1990. The second subset of the data includes all individuals who were affected by the introduction of this compulsory schooling law, that is, all those who were born in 1996 and after 1996. Figure 6.1 shows the percentage of individuals within each subgroup along with their highest qualification levels.

introduction of the law. The 7th year is where the child generally reaches the minimum age at which s/he is allowed to leave primary schooling.[108] The law basically kept at school, those individuals who would have otherwise dropped out of the primary school cycle and also provided a second attempt at grade 6 national examinations to students who failed to pass during their first attempts.

Figure 6.1: The impact of the 1993 Basic Compulsory Schooling Act on individuals' highest schooling attainments.



Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

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[108] However some children may turn 12 in the 6th year and the law allows them to leave primary schools during that particular year. This may explain the relatively higher percentage of individuals who left school (after the implementation of the 1993 basic compulsory education law) after their 6th year at school compared to those prior the implementation of this law.

Indeed Figure 6.1 reveals that this law allowed a greater percentage of individuals (post treatment) to stay on until grade 6 (that is,Year 7), after which they dropped out. Also the opportunity to have a second attempt at the national examinations at end of year 7, encouraged individuals to move to the secondary school cycle, for instance, there has been an increase in individuals leaving secondary schooling after Year 8 (Form 1) and Year 9 (Form 2). Besides national statistics support this finding: three years prior to the 1993 basic compulsory education law, the gross enrolment ratio for both sexes in secondary schools was 48% and three years after the law, the gross enrolment ratio rose to 53% (CSO 2006) Post treatment individuals are denoted by the green bars and pre treatment individuals are denoted by the red bars.

However as will be argued in Section 6.5, the first stage regressions of the IV procedure reveal that the coefficient on the dummy variable 'msl', capturing the effect of the introduction of the basic compulsory schooling law is negative in all cases. This may be attributed to the fact that most individuals who were affected by this law are still at school and have yet to make their way to the labour market[109]. Subsequently this instrument is dropped as it cannot be used to predict the schooling of individuals.

[109] The law was passed in 1993 and the data used for this study was collected in 2000, implying that the individual was around 19 years, and unless he/she dropped out, he/she would be still within the secondary school cycle

6.2.2 Using the 1976 Free Access to Secondary Education law as an instrument

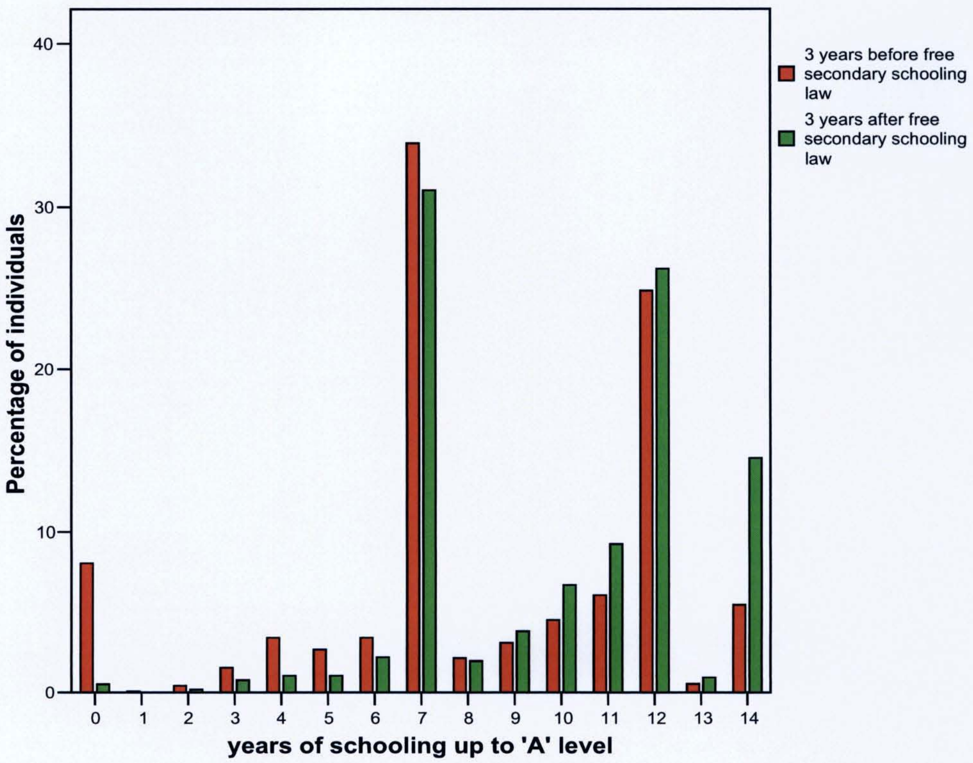
The free access to secondary schooling law was introduced in 1977 and it made secondary schooling free for all school-age youths. This was thought to be a potential instrument as it has no direct impact on earnings and is likely to predict the schooling attainments of individuals, as free education would be likely to encourage greater participation particularly among poorer students. This law was incorporated into the model through the use of a dummy variable, 'free'. Like the previous dummy variable 'msl' for the compulsory education instrument, 'free' is designed to be based on the individual's age. The dummy variable 'free' was defined such that it takes the value of 1 for individuals who were affected by the introduction of free secondary schooling, that is, those born after 1958 and, thus, who faced a regime of no fees at secondary school. The dummy variable took a value of 0, otherwise[110].

Figure 6.2 displays the effect of the free secondary schooling policy on an individual's highest schooling attainment, three years prior to and three years after the implementation of the law. It clearly shows that this law

[110] In 1977, secondary schooling was made free for all school-age youths which is generally within the age group of 12 to 19 years for the Republic of Mauritius. Thus, for the individual to be affected by this law, s/he should have been within the age range of 12 to 19 in 1977 and by the time of the 2000 Population Census, s/he would have turned at most 42 years old. Thus, for all those affected by this law, the dummy variable 'free' will be equal to 1 with the age variable being less or equal to 42 and for those unaffected by this law, 'free' will be equal to 0 with the age variable being above 42.

did predict the schooling of individuals. The achievements of those individuals, who started secondary school after the law was implemented, were higher than the achievements of those individuals born 3 years before the law was implemented. There is a greater percentage of individuals from the post treatment group who finished the secondary school cycle (up to 'A' level) when compared to the other group.

Figure 6.2: The impact of the 1976 Free Secondary Education law on individuals' highest schooling attainments.



Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Here the free secondary education policy may be used as an instrument to estimate returns to schooling on the basis that a subgroup of individuals exists who would have chosen a lower level of education without the reform. Thus, the 1976 free access to secondary schooling law is used throughout this chapter.

However as will be shown in Section 6.4, this instrument is significant mainly in the case of women and statistically insignificant in the case of men, which is nevertheless relevant to existing literature on the education of girls in the Republic of Mauritius. It has been reported that free access to secondary education led to a doubling in the enrolment rate of girls in secondary schools within the Republic of Mauritius, over the period 1977 to 1990 (Naugah & Poonet, 1996). Besides even Brooks (2000) states:

> "Since Mauritius introduced free education in 1977, girls have enjoyed increasing equality of opportunity in the island's education system, as families were no longer forced to concentrate their resources on the male children they believed would benefit more from schooling." (Brooks, 2000; p.1)

Instruments, however in conclusion, are not easily and readily available in data for the Republic of Mauritius, the 1976 free access to secondary schooling law was deemed an appropriate instrument to predict schooling behaviour at least for women. All regressions based on the IV procedure (in this chapter) include this instrument.

6.3 Model specification and estimation issues

It must also be pointed out that there is a possibility of different instruments affecting different margins of the schooling distribution (Card, 1999; Harmon & Walker, 1999). In a conventional model where the variable 'years of schooling' is linear in its effect, estimates are relatively stable with respect to the choice of instruments. But once the linearity assumption is relaxed (which may be done, for instance, by including a measure of years of post secondary education[111]), large and different returns are reported. Also as argued by Card (1999), the results become more sensitive to the choice of instruments once the marginal years of higher level of schooling (for example, 'years of post secondary education') are included in the model.

Despite the fact that recent studies have been critical of the linear assumption with respect to schooling (Heckman et al, 1995; Harmon & Walker, 1999; Card, 1999), for the purpose of this thesis, the model is restricted to the linearity assumption. Instruments are not widely and easily available in the context of the Republic of Mauritius and non-linear models (with respect to schooling) are sensitive to the choice of instruments. Thus, the linearity assumption remains most appropriate.

[111] The inclusion of the 'post secondary education' variable in addition to the 'total number years of schooling' captures the possibility that the marginal returns of schooling beyond this level differ from the returns to schooling up to this level.

This is consistent with much of the existing IV literature in which the "specification of the earnings function has typically assumed that log wages are linear in years of schooling" (Harmon & Walker, 1999; p.880). Thus all IV estimates for the purpose of this thesis, are computed based on the assumption that each additional year of schooling yields the same return.

The model specification used throughout the analysis is not subject to finite sample bias. The finite sample bias arises because we do not know the first stage coefficient γ in equation 6.2. Instead we use estimates which imply a certain amount of overfitting of the first stage equation, causing a bias in the direction of OLS (Sawa, 1969; Nelson & Startz, 1990; Bound et al, 1995) and as $R^2_{S,Z} \rightarrow 0$, the finite sample bias of IV is of the same magnitude as the OLS bias. This bias is particularly severe in small samples. However Bound et al (1995) argue that even those working with large cross-sectional samples can suffer from finite sample biases if the relationship between the instruments and the endogenous explanatory variable is weak and they recommend that researchers should be cautious when adding instruments to increase precision. The F-statistics on the excluded instruments in the first stage regression of IV contains valuable information about the magnitude of the finite sample bias of IV relative to OLS and, if the F-statistics is close to 1, there is cause for concern. They argue that the partial R^2 and F-statistics on the excluded instruments in the first stage regression act as rough guides to the quality of the IV estimates. However the IV estimates presented in subsequent sections are not subject to the finite sample bias as a single instrument is used for the IV procedure and it is strongly correlated with schooling.

If schooling were not endogenous, the OLS would generate more efficient estimates than the IV procedure (Pons & Gonzalo, 2002), as has been discussed. I follow the recommendation made by some researchers and present the Durwin-Wu-Hausman test for each regression (Hausman 1978; Davidson & Mckinnon, 1993; Pons & Gonzalo, 2002). Thus throughout this chapter, I report whether or not the use of IV is warranted while estimating the social returns to education. In the case of men, there is insufficient evidence to suggest that their schooling is endogenous and this is due to the use of a poor instrument (in the absence of any other instrument) while for women, there is sufficient evidence to suggest that OLS estimates are inconsistent in most cases.

Similar to previous chapters, all tables in this chapter only report the coefficients on the explanatory variables of interest and do not report coefficients on the other explanatory variables which are explored in the appendix. Coefficients on the instrument used, on the 'years of schooling' variable and on the intercept term along with the R^2 values, partial R^2

values, F-tests on the excluded variable and Durbin-Wu-Hausman χ^2 tests are reported in each table presented in this chapter. All equations have been carried out using robust estimates.

6.4 Marginal returns to schooling for the Republic of Mauritius

6.4.1 Marginal returns to schooling for both sexes

The IV procedure generates the marginal returns among the low education sub-group and these returns are relatively high as these reflect the high marginal costs of schooling to this group, potentially as a result of their low ability (Card, 2000; Card, 2001). Let us consider the social returns to an extra year of schooling when each instrument is used separately. As reported in Table 6.1, the OLS estimate for an extra year of schooling is smaller than that estimated by the IV procedure and this result is in line with the majority of results in the literature.

Table 6.1 Schooling and wage equations for both sexes with schooling legislation instruments

Variables	Schooling equations		Wage equations		
	Basic compulsory education	Free secondary education	Basic compulsory education	Free secondary education	OLS estimates
Basic compulsory education	-1.414***				
Free secondary education		0.395*			
Years of schooling			0.14***	0.19*	0.07***
Constant	10.386***	8.651***	0.839**	0.279	1.415***
R^2	0.209	0.19*	0.306	0.01	0.412
Test results:					
Partial R^2			0.006	0.0008	
F-test on excluded variables			$F(1, 4246)$ 23.28***	$F(1,4245)$ 3.53*	
Durbin-Wu-Hausman χ^2 test on exogeneity			4.586**	2.092	
N	4256	4256	4256	4256	4256

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius
*** significant at 1% level, ** significant at 5% level, * significant at 10% level

However as can be deduced from Table 6.1, the schooling equation using the basic compulsory education policy cannot be used to predict schooling attainment of individuals. The first stage regression suggests that compulsory schooling up to age 12 does not stimulate schooling and that the law is associated with a significant decrease in the expected length of schooling. Thus, although the F-tests on the excluded variables and the partial R^2 on the first stage regression suggest that this instrument is strongly correlated with the endogenous variable (years of schooling), the

1993 basic compulsory education law is dropped from further analysis. As mentioned earlier, the negative coefficient of the basic compulsory education instrument in the first-stage regression may be attributed to the fact that those affected by this law are still at school. This law was enacted in 1993 for children below the age of 13 and the data set used for this PhD was collected in 2000, leaving a gap of only 7 years. Thus at the time of the population census, any individual who was affected by this policy would have turned at most 19 years old - an age at which an individual is still supposed to be within the secondary school cycle. It is thus too early to use this as an instrument, although future research should make use of it.

In the IV model used in the rest of this chapter, identification is achieved only through the inclusion of the free secondary schooling law dummy variable and this is positive and statistically significant at the 10% level in the schooling equation for both sexes, and although it is weakly correlated to schooling. The F-test value on the excluded variable is low and as will be shown later, the instrument is particularly weak for men. The law is associated with an increase in the expected length of schooling. The suggested estimate of social returns to schooling for the marginal group of individuals is 19%.The F-test is significant at 10 % level. However when I carried out the Durwin-Wu-Test to test for the conclusion of endogeneity of schooling [following Pons & Gonzalo (2002) and Patrinos &

Sakellariou (2004)], there is insufficient evidence to reject the null hypothesis that OLS estimates are consistent.

6.4.2 Marginal returns to schooling by gender

Even when the sample is split by gender (Table 6.2.1 & Table 6.2.2), the same main pattern is observed. IV estimates to years of schooling are higher relative to those generated by the OLS technique. As has been said, the estimates are consistent with recent findings which suggest that the sub-groups affected by the policy intervention have larger returns to schooling than the average returns suggested by the OLS technique. The IV procedure yields marginal returns of around 12.7% for men only and around 16% for women only.

However as pointed out in the literature, IV procedures which make use of weak instruments yield more inconsistent point estimates than those produced by the conventional OLS (Bound et al, 1995; Levin & Plug, 1999). Thus, I conducted the F-test on the excluded variable for men only which is statistically insignificant and also the partial R^2 for men only suggests that the instrumental variable did not improve the R^2 value of the first stage equation. The correlation between schooling and the free secondary education instrument is very weak. This may explain the highly insignificant return estimate of 12% for men only. This is illustrated in Table 6.2.1.

Table 6.2.1 Schooling and wage equations <u>for males only</u>, with schooling legislation instrument

Variables	**Schooling equation**	**Wage equations**	
	IV estimates	OLS estimates	IV estimates
Free secondary education	-0.0322		
Years of schooling		0.065***	0.14
Constant	6.232***	1.471***	1.04
R^2	0.120	0.351	0.22
Test results:			
Partial R^2			0.000
F-test on excluded variables			F(1, 2896) 0.02
Durbin-Wu-Hausman χ^2 test on exogeneity			0.003
N	2905	2905	2905

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius
*** significant at 1% level, ** significant at 5% level, * significant at 10% level

In the case of men only, there is insufficient evidence to reject this null hypothesis (H_0: $\beta_{OLS} = \beta_{IV}$) due to the poor instrument. Thus, it may be concluded that this instrument cannot be used in the case of men, however, I will present full results (including those for men) for completeness.

Table 6.2.2 Schooling and wage equations <u>for females only</u>, with schooling legislation instrument

Variables	Schooling equation	Wage equations	
	IV estimates	OLS estimates	IV estimates
Free secondary education	1.236***		
Years of schooling		0.075***	0.152***
Constant	11.171***	1.147***	0.261
R^2	0.413	0.478	0.356
Test results:			
Partial R^2			0.007
F-test on excluded variables			F(1,1342) 10.22***
Durbin-Wu-Hausman χ^2 test on exogeneity			2.716*
N	1351	1351	1351

Source: Computed from 2000 Population Census Data, CSO, Mauritius
*** significant at 1% level, ** significant at 5% level, * significant at 10% level

In contrast, in the case of women, free secondary education is strongly correlated with schooling. This is illustrated in Table 6.2.2. The F-test on the excluded variable for women only is significant at 1% level and the partial R^2 suggests that the addition of the identifying variable to the reduced form equation improves the R^2 value of that equation. Thus the criteria of instrumental quality as proposed by Bound et al (1995), that there should be a strong correlation between the instrument and schooling is satisfied in the case of women only. When the exogeneity test (Durbin-Wu-Hausman test), is carried out the null hypothesis that OLS estimates do not differ from IV estimates, is rejected at the 10% level of significance, for females only. Thus, the OLS estimate is not consistent and the suggested estimate of social returns to schooling for the marginal group of women is 16%.

Similar to the conventional OLS, the IV procedure suggests that women enjoy higher social returns to schooling when compared to their male counterparts. IV estimates of social returns to an extra year of schooling for men only and women only are on the order of 12.7% and 16%, respectively, compared to the corresponding OLS baseline estimates of 6.4% and 7.2%, implying that OLS estimates of social returns to an extra year of schooling are biased downwards. However the free secondary schooling instrument does not predict the schooling attainment of men particularly well. Bound et al (1995) argues that the use of such instruments produces estimates with large standard errors, leading to inconsistencies in the IV estimates. They also argue that in finite samples IV estimates are biased in the same direction as OLS estimates, with the magnitude of the bias approaching that of OLS as the R^2 value between the instruments and the endogenous variable approaches zero.

Thus, as can be deduced from Table 6.2.1 and Table 6.2.2, the effect of the 1976 free secondary education law affected mainly girls and this is in line with what has been reported elsewhere for the education for girls in the Republic of Mauritius (Brooks, 2000). Therefore, I emphasise the IV results for women only.

6.4.3 Marginal returns to schooling by sector of employment

In this section, I use the IV procedure to estimate the social returns to schooling for private sector employees only and for public sector employees only, so as to take into account the inconsistency associated with OLS estimates due to the endogeneity problem between these sectors.

I first consider the social returns derived by private sector employees only for both sexes. Table 6.3.1 presents the results.

Table 6.3.1 Schooling and wage equations for private sector employees only, with the schooling legislation instrument

Variables	Schooling equation	Wage equations	
	IV estimates	OLS estimates	IV estimates
Free secondary education	0.247		
Years of schooling		0.064***	0.336***
Constant	8.537***	1.487***	-0.843
R^2	0.15	0.296	-1.721
Test results:			
Partial R^2			0.0003
F-test on excluded variables			F(1, 3427) 1.00
Durbin-Wu-Hausman χ^2 test on exogeneity			2.885*
N	3436	3436	3436

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius
*** significant at 1% level, ** significant at 5% level, * significant at 10% level

As shown in Table 6.3.1, the IV estimate to schooling in the case of private sector employees only is higher than that generated by the OLS technique. However the instrument is statistically insignificant in the first stage equation and the F-test on the excluded variable is also insignificant. The correlation between the free secondary education instrument and schooling is very weak and this instrument may not be used accurately to estimate returns to schooling. The weak correlation explains the incredibly inflated IV return estimate of 36% while the conventional OLS generates a social return of 6.3% only. But both estimates are statistically significant at a 1% level and the partial R^2 value reveals that the instrumental variable improves the R^2 value of the first stage equation. I also inquired whether it was necessary to correct for the potential endogeneity of schooling and I performed the Durbin-Wu Hausman test. This exogeneity test rejects the null hypothesis of no difference between the OLS and IV estimates at the 10% level of significance.

Table 6.3.2 Schooling and wage equations for public sector employees only, with schooling legislation instrument

Variables	**Schooling equation**	**Wage equations**	
	IV estimates	OLS estimates	IV estimates
Free secondary education	0.43		
Years of schooling		0.089***	-0.013
Constant	19.975***	2.129***	4.22
R^2	0.252	0.437	0.07
Test results:			
Partial R^2			0.002
F-test on excluded variables			F(1, 811) 1.26
Durbin-Wu-Hausman χ^2 test on exogeneity			0.823
N	820	820	820

Source: Computed from 2000 Population Census Data, CSO, Mauritius
*** significant at 1% level, ** significant at 5% level, * significant at 10% level

Table 6.3.2 shows the results of the IV procedure and OLS technique when public sector employees only are considered. Social return to schooling derived from the IV technique is negative and statistically insignificant. For the IV procedure, in the first stage regression itself, the coefficient on the free secondary education variable is insignificant. Thus, standard errors of the 'years of schooling' variable in the IV estimates of the earnings equation rise, making it insignificant. The quality tests show that the correlation between the instrument and schooling is weak and cannot generate an accurate estimate of social returns to schooling. The Partial R^2 is close to zero and the F-test on the excluded variable is insignificant. Furthermore the exogeneity test suggests that schooling is not endogenous and thus, the null hypothesis that OLS estimates are consistent cannot be rejected. However it must be pointed out that the sample of individuals within the public sector only, is small.

The sample is split further by gender in each sector although results for the sample of males are not expected as the previous sections showed that the instrument does not explain the schooling of men. However for the sake of completeness, all results for men as well as women only are presented in this section. Thus, Table 6.3.3 shows the results when the IV procedure and the OLS technique are used to estimate the social returns to schooling for males only for the private sector and public sector, respectively.

Table 6.3.3 Schooling and wage equations for private sector male employees only and public sector male employees only, with schooling legislation instrument

Variables	Schooling equation (First stage regressions)		Wage equations OLS estimates		IV estimates	
	private sector males only	Public sector males only	private sector males only	public sector males only	private sector males only	public sector males only
Free secondary education	-0.420	0.393				
Years of schooling			0.059***	0.087***	0.057	-0.010
Constant	5.975***	25.39***	1.466***	2.388***	1.482**	4.903
R^2	0.071	0.178	0.238	0.398	0.238	0.035
Test results:						
Partial R^2					0.001	0.0012
F-test on excluded variables					F(1,2272) 2.14	F(1,617) 0.74
Durbin-Wu-Hausman χ^2 test on exogeneity					0.0004	0.453
N	2280	625	2280	625	2280	625

Source: Computed from 2000 Population Census Data, CSO, Mauritius
*** significant at 1% level, ** significant at 5% level, * significant at 10% level

The free secondary education instrument exerts a negative and insignificant effect for men only in the private sector, and its coefficient is positive but statistically insignificant in the case of public sector male employees only. These are consistent with previous results whereby it was reported that free secondary education does not predict schooling for men. Thus, the instrument neither predicts the schooling of private sector male workers nor that of public sector male workers. The Partial R^2 and the F-test on the excluded variable in the case of men only employed in both sectors, confirm that the correlation between the instrument and schooling is weak. As a result of this weak correlation, there is an increase in the standard errors of the estimated coefficients of schooling in the wage regressions which generates insignificant estimates to social returns to schooling. Moreover when the Durbin-Wu Hausman test of exogeneity is carried out, there is insufficient evidence to reject the null hypothesis that schooling is exogenous. However it must be pointed out that the instrument is very weak in the case of men, thus, it is not advisable to conclude that men who work in the private sector or in the public sector choose their level of schooling.

Conventional OLS, on the other hand, yields an estimate of 6% for private sector male employees only and 9% for and public sector male employees only. When the wage equations are estimated by OLS, it explains 36% of the variations in gross incomes of public sector male workers and 23% of the variations in gross incomes of private sector male workers. Also when returns are compared for males only, between the public and private sectors, the OLS technique suggests that men get relatively higher returns to their schooling (around 3 percentage points) in the public sector rather than in the private sector. Thus, after controlling for other factors such as age and tenure[112], it may be concluded that a man is likely to enjoy a relatively higher wage premium in the public sector.

[112] All explanatory variables which are used here are similar to those used in Chapter 5. Please refer to appendix for full table of results.

I next consider the sub sample of women only by sector of employment. Table 6.3.4 and Table 6.3.5 present the results from the IV procedure and the OLS technique for women only who are employed in the private sector and public sector, respectively.

Table 6.3.4 Schooling and wage equations for private sector female employees only, with schooling legislation instrument

Variables	**Schooling equation**	**Wage equations**	
	IV estimates	OLS estimates	IV estimates
Free secondary education	1.527***		
Years of schooling		0.073***	0.166***
Constant	11.764***	1.248***	0.123
R^2	0.348	0.287	0.048
Test results:			
Partial R^2			0.048
F-test on excluded variables			F(1, 1148) 12.04***
Durbin-Wu-Hausman χ^2 test on exogeneity			4.057**
N	1156	1156	1156

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius
*** significant at 1% level, ** significant at 5% level, * significant at 10% level

When the social returns to schooling for private sector female employees only are considered, it can be deduced that the IV estimate for schooling (17 %) is higher than the OLS estimate (7%), highlighting the fact that OLS estimates may be biased downwards. However emphasis must be laid on the fact that the IV approach provides LATE estimates and thus OLS estimates and IV estimates are not directly comparable. The IV estimate is significant at a 5% level of significance. The first stage regression shows that the instrument has a positive and highly significant impact on the schooling attainment of those women who work in the private sector. Instrumental quality is ensured as the F-test on the excluded variable reveals that the instrument is strongly correlated to their schooling and the partial R^2 shows an improvement in the R^2 value of the reduced form equation when the instrument is added to it. The relevance of IV is also confirmed in case of private sector female workers when the Durbin-Wu Hausman Chi-Square test on exogeneity is carried out. There is sufficient evidence (at 5% level of significance) to reject the null hypothesis that OLS estimates are consistent, suggesting that it is necessary to engage in the IV corrective procedure. The use of the free secondary education instrument suggests a significant increase and higher estimate (10 percentage points) of the return to schooling for private sector female workers.

Table 6.3.5 Schooling and wage equations for <u>public sector female employees only</u>, with schooling legislation instrument

Variables	**Schooling equation**	**Wage equations**	
	First stage regression	OLS estimates	IV estimates
Free secondary education	0.598		
Years of schooling		0.092***	-0.026
Constant	9.574**	1.807***	3.003
R^2	0.45	0.540	0.239
Test results:			
Partial R^2			0.004
F-test on excluded variables			F(1,187) 0.70
Durbin-Wu-Hausman χ^2 test on exogeneity			0.477
N	195	195	195

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius
*** significant at 1% level, ** significant at 5% level, * significant at 10% level

As reported in Table 6.3.5, the OLS yields a social return to schooling which is around 9% and this estimate is highly significant[113]. However the equivalent figure derived through the IV procedure is negative and highly insignificant. The first stage regression reveals that this instrument does not predict the schooling attainment of those women who work in the public sector. The instrument has a positive coefficient but is insignificant in its effect on schooling for public sector female workers. This weak correlation causes an increase in the standard error of the estimated coefficient of schooling in the wage equation, which explains the insignificance of the schooling variable in the wage regression. Bound et al (1995) suggest that if the relationship between the instrument and the endogenous explanatory variable is weak, then even huge samples will not eliminate important finite sample biases. Also, Sawa (1969) states that the IV finite sample bias is in the same direction as the OLS bias and has the same magnitude as the R^2 (of the schooling equation with the instrument) approaches zero. Here it must be pointed out that the sample of women who work in the public sector is very small (195 women only). Bound et al (1995) suggest examining the F-tests on the excluded instrument(s) to investigate the possibility of finite sample bias and for the current group (public sector female employees), the F statistics is less than 1. Hence it is

[113] As has been previously said in Chapter 3, when a comparison is made between the private and public sector, OLS reports that women are likely to enjoy a higher wage premium in the public sector and this also applies in the case of men.

cause for concern. However its coefficient here is insignificant. We do not therefore place emphasis on the results for women in the public sector.

6.4.4 Marginal returns to schooling by place of residence

In this section, I look at the difference between rural/urban social returns to schooling. We note firstly that these differences reflect the prevailing labour market situation in those areas as residents in rural areas may have had schooling in urban areas and vice versa (Duraisamy, 2002). Also I recognise the endogeneity of residential choice although I do not address it in this chapter as my stress rests upon the endogeneity of schooling. I first use OLS and then the IV procedure to estimate social returns to schooling in an attempt to generate consistent estimates in the presence of ability bias, measurement error and endogeneity of schooling.

The IV procedure reveals that all estimates to social returns to an extra year of schooling are higher than those generated by the conventional OLS[114]. However it must be pointed out that instrumental quality is not ensured as the correlation between the free secondary education instrument and schooling is weak for most sub groups (for rural workers only, for urban workers only, for rural male workers only, for urban male workers only and for rural female workers only). This is of course

[114] Exceptionally the IV estimate for social return to schooling for urban male workers are lower than the OLS estimate.

because the previous analysis suggests that the IV does not work for males. These results are reported for completeness only. This explains the highly insignificant coefficients on the IV estimates of schooling in the wage equations. While the partial R^2 value reveals that the instrumental variable slightly improves the R^2 value of the first stage equation, the F-test on the excluded variable is highly insignificant. Also there is insufficient evidence to reject the null hypothesis that the OLS estimates are consistent, with the important exception of the case of urban female workers only, suggesting that it is not necessary to engage in the IV corrective procedure to account for endogeneity of schooling. Below I present and discuss all of the results by referring to each sub-group.

In Table 6.4.1, both the OLS and the IV estimates of returns to schooling differ in magnitude which is in line with the mainstream literature. OLS produces an estimate of social returns to schooling of around 5% for rural workers only and 9.3% for urban workers only, while the equivalent figures generated through the IV procedure are 13.2% and 29.3%, respectively[115]. This implies that the OLS estimate may be biased downwards abut it must be acknowledged that IV estimates measure marginal returns for a marginal group of the population who would not

115 Note that these estimates are obtained after controlling for other individuals' characteristics such as age, age squared, tenure, tenure squared, nationality, gender and sector of employment. In other words the same model specifications (for OLS estimation and the IV procedure) are used here as in the previous sections and full tables of results are in Appendix 2.

have received the treatment otherwise. However emphasis must be laid on the fact that the OLS estimates are significant at a 1% level while both IV estimates are statistically insignificant, reflecting the weakness of the instruments in these specifications.

Table 6.4.1 Schooling and wage equations for both sexes by area of residence

Variables	Schooling equation First stage regressions		Wage equations OLS estimates		IV estimates	
	Rural workers only	Urban workers only	Rural workers only	Urban workers only	Rural workers only	Urban workers only
Free secondary education	0.350	0.414				
Years of schooling			0.052***	0.094***	0.135	0.255
Constant	6.675***	9.331***	1.522***	1.127***	0.962	-0.402
R^2	0.219	0.140	0.388	0.435	0.197	-0.105
Test results:						
Partial R^2					0.0001	0.001
F-test on excluded variable					$F(1,2425)$ 1.49	$F(1,1813)$ 1.86
Durbin-Wu-Hausman χ^2 test on exogeneity					0.467	1.788
N	2434	1822	2434	1822	2434	1822

Source: Computed from 2000 Population Census Data, CSO, Mauritius
*** significant at 1% level, ** significant at 5% level, * significant at 10% level

When the IV procedure is used, instrumental quality is not ensured. In other words, the results associated with the use of the 1996 free access to secondary education law cannot be used in the case of rural workers only and urban workers only as the correlation between the instrument and schooling is weak. Here the IV procedure will not generate accurate estimates of social returns to schooling. The first stage regressions reveal that the coefficients on the instrument are positive but insignificant in both cases so the instrument does not predict schooling. The Partial R^2 does not show much improvement in the R^2 value of the reduced form equation once the identifying variable is added but the F-tests on the excluded variables in the first stage are insignificant. Thus in the case of rural and urban residents, one need be concerned about IV yielding more inconsistent point estimates than those produced by OLS.

OLS suggests that those who live in urban areas enjoy higher social returns to their schooling (around 4 percentage points) when compared to their counterparts in rural areas[116]. The same pattern is reported when the IV procedure is used. The IV estimates indicate that urban residents enjoy a wage premium which is around 16% percentage points higher than those enjoyed by rural residents.

Following Levin & Plug (1999), I checked whether it is necessary to engage in the 'corrective' procedure to deal with potential endogeneity of schooling for those workers who reside in rural areas only and in urban areas only. The Durbin-Wu-Hausman reveals that the endogeneity of schooling does not have a significant effect on the estimated schooling return and thus, may suggest that the use of IV is not warranted in the case

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[116] Please note that similar findings were reported in Chapter 5 when the qualification variables were used instead of the 'years of schooling' variable. Refer to Table 5.3.1.

of both sexes for rural residents only and urban residents only. This however is based on the weak instrument and therefore is inconclusive.

I also explored potential differences in social returns to schooling by gender between rural and urban areas. I first present the case for men only between these areas. Table 6.4.2 presents the results from the IV procedure and the OLS technique for men only who reside in rural areas and urban areas, respectively.

Table 6.4.2: Schooling and wage equations for men only by area of residence

Variables	**Schooling equation** First stage regressions		**Wage equations** **OLS estimates**		**IV estimates**	
	Rural men only	Urban men only	Rural men only	Urban men only	Rural men only	Urban men only
Free secondary education	-0.109	0.118				
Years of schooling			0.053***	0.081***	0.117	0.023
Constant	4.257***	7.975***	1.257***	1.610***	0.983	2.077
R^2	0.146	0.062	0.311	0.396	0.192	0.313
Test results:						
Partial R^2					0.0001	0.0001
F-test on excluded variable					F(1,1691) 0.11	F(1,1198) 11.29
Durbin-Wu-Hausman χ^2 test on exogeneity					0.020	0.015
N	1699	1206	1699	1206	1699	1206

Source: Computed from 2000 Population Census Data, CSO, Mauritius
*** significant at 1% level, ** significant at 5% level, * significant at 10% level

The OLS estimate to schooling in the case of rural men only is as expected, lower than the IV estimates. The IV estimate to an extra year of schooling is of the order of 12% in the case of rural men only and the equivalent figure generated by OLS The Durbin-Wu-Hausman is 5%. This suggests that the OLS estimate to social return to schooling may be biased downwards. However it must be pointed out that the coefficient on schooling in the first stage regression is negative, implying that the 1976 free secondary education law is associated with a decrease in the expected length of schooling for those men who reside in rural areas. But this coefficient is insignificant. We therefore discount these results due to weak instruments.

Also while the OLS estimate to an extra year spent at school is significant at the 1% level, the equivalent IV estimate is insignificant. This also applies in the case of urban men only. However, IV generates a lower social return to their schooling than the conventional OLS (2.5% versus 8%). In the case of both rural men and urban men, F-tests on the excluded variable prove that the instrument and schooling are weakly correlated and their partial R^2 values do not suggest that the addition of the instrument to the reduced form equation improves their respective R^2 values. Also when the endogeneity test is carried out, there is insufficient evidence to reject the null hypothesis: $\beta_{OLS}=\beta_{IV}$ as the Durbin-Wu-Hausman test is insignificant in each case which again suggests that the use of IV is unwarranted but this result is on the basis of a weak instrument.

Next I consider the sub-sample of women only between rural and urban areas (Table 6.4.3 and Table 6.4.4).

Table 6.4.3 Schooling and wage equations for <u>those women who reside in rural areas only</u>

Variables	Schooling equation	Wage equations	
	IV estimates	OLS estimates	IV estimates
Free secondary education	1.443***		
Years of schooling		0.049***	0.075
Constant	9.471***	1.695***	1.441***
R^2	0.409	0.416	0.397
Test results:			
Partial R^2			0.01
F-test on excluded variables			6.97***
Durbin-Wu-Hausman χ^2 test on exogeneity			0.234
N	735	735	735

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius
*** significant at 1% level, ** significant at 5% level, * significant at 10% level

It can be deduced from Table 6.4.3 that instrumental quality is ensured. In other words the instrument chosen actually predicts the level of schooling acquired by women in rural areas. The first stage regression shows that the 1976 free secondary education law is associated with an increase in the expected length of schooling for women in rural areas and this coefficient is highly significant. The F-test on the excluded variable for these women is significant at 1% level and the instrumental variable improves the R^2 value of the first stage equation. The correlation between the 1976 free secondary education instrument and schooling is strong. The IV procedure yields an estimate of social returns to schooling of around 7% while that obtained through the conventional OLS is around 5%. This again suggests that OLS estimates may be biased downward, which is in line with existing literature, although it must be pointed out that IV estimates are LATE estimates. However when the relevance of IV in the case of rural women only, is assessed through the Durbin-Wu-Hausman test for endogeneity of schooling, the coefficient derived is insignificant, suggesting that there is insufficient evidence to reject the null hypothesis that the OLS estimate is consistent. Besides the IV estimate to social returns to schooling for women who reside in rural areas only is insignificant while that of OLS is significant at 1% level.

Table 6.4.4 **Schooling and wage equations for <u>those women who reside in urban areas only</u>**

Variables	**Schooling equation**	**Wage equations**	
	IV estimates	OLS estimates	IV estimates
Free secondary education	1.100**		
Years of schooling		0.112*	0.266**
Constant	10.8***	0.192	-1.493
R^2	0.318	0.490	0.155
Test results:			
Partial R^2			0.007
F-test on excluded variables			F(1,608) 4.26**
Durbin-Wu-Hausman χ^2 test on exogeneity			3.195*
N	616	616	616

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius
*** significant at 1% level, ** significant at 5% level, * significant at 10% level

Considering the case of urban women only, it can be concluded that the instrument predicts their schooling (Table 6.4.4). The coefficient on the free secondary education instrument is positive and significant at a 5% level in the first stage regression. The F-tests on the excluded variable along with the partial R^2, suggest that there is a satisfactory correlation between the instrument and schooling for urban women. The IV estimate is around 27% while that generated by the conventional OLS is around 11%, indicating the presence of a large and negative bias in OLS estimates of the schooling-earnings relationship in the case of urban women. However it must be pointed out that IV estimates are LATE estimates and thus, they are yielding marginal returns to schooling for those individuals who would have low schooling had the intervention not occurred. These individuals tend to have high discount rates (Harmon & Walker, 1999).

The IV estimate of social returns to schooling for urban women is significant at a 5% level and that of the conventional OLS is significant at a 10% level. Also, when the relevance of IV is assessed, the coefficient of the Durbin Wu-Hausman test of exogeneity is significant at 5% level, which means that the null hypothesis that OLS estimate is consistent may be safely rejected. Thus, in the case of urban women only, the use of IV is warranted.

6.5 Concluding note

Some researchers have successfully exploited changes in the legislation pertaining to schooling such as a rise in the minimum school leaving age or the introduction of free education to identify the return to education (Pons & Gonzalo, 2002; Levin & Plug, 1999; Harmon & Walker, 1995). I use the introduction of the 1976 free secondary education law whereby secondary schooling became free to all school age youth to do the same. The validity tests show that the 1976 free secondary education law and the years of schooling are satisfactorily correlated for women at least, and may be used to estimate IV social returns to schooling. This instrument has a positive and significant impact on the expected length of the individual's schooling in the case of women. Another potential instrument was thought to be the 1993 basic compulsory education law whereby primary schooling became compulsory up to the age of 12 (inclusive). But the first stage regression revealed that it does not predict individuals' schooling attainment. It is associated with a decrease in the expected length of schooling for individuals. This may be attributed to the fact that this law was recently introduced and most individuals who are affected by it, are still at school. Therefore this instrument was dropped from subsequent analysis.

Social returns to schooling generated by the conventional OLS in all cases (for both sexes, by gender, by sector of employment and by place of residence) are of the expected signs and are statistically significant at a 1% level. On the other hand, IV estimates of returns to an extra year of schooling are significant in some cases such as in the cases of women only, private sector employees only and urban women only. But all IV estimates to social returns to schooling are higher than those generated by the conventional OLS[117]. This is in line with the consensus that OLS estimates of the returns to education may be biased downwards. However emphasis must be laid on the fact that IV estimates are LATE estimates which measures returns for the marginal group.

[117] This holds true in all cases except for that of urban men. However the IV estimate to schooling for urban men is statistically insignificant.

When the sample for both sexes is considered, the 1976 free secondary education instrument is only significant at a 10% level in the first stage regression. However its addition improves the R^2 value of that regression and the f-test on the excluded variable is significant at a 5% level which confirms that instrumental quality is ensured. The IV estimate to social returns to schooling is significant at a 10% level while that obtained through the conventional OLS is significant at a 1% level. The IV estimate is 13.2 percentage points higher than the OLS estimate. However there is no evidence of endogeneity of schooling when the relevance of IV is assessed, partly reflecting the relative weakness of the instrument for this sample.

However in the case of men only, the instrument (1976 free access to secondary schooling) does not predict the schooling of men, and the results in each section (Section 6.4.2, Section 6.4.3 & Section 6.4.4) reinforces this conclusion. The coefficients on the instrument are negative in the first stage regressions. The quality tests reveal that the instrument does not improve the value of the first stage regressions, and the f-tests on the excluded variable are insignificant in the case for men. The IV estimate to an extra year of schooling for men only is statistically insignificant although it is 6.3 percentage points higher than the OLS estimate. The Durbin-Wu-Hausman Chi square test suggests that it is not necessary to engage in a 'corrective' procedure to deal with potential endogeneity of schooling for men only and thus, the use of IV is not warranted in the case of men only. This however reflects instrument weakness. In the absence of any other instrument in the case of men only in the Republic of Mauritius, the conventional OLS must be used to obtain estimates of social returns to schooling. One must however be aware that these estimates are likely to be upward biased.

In the case of women only, the instrument (1976 free access to secondary schooling) predicts the schooling of women well. IV estimates to social returns to schooling for women are constantly and significantly higher than those generated by the conventional OLS. For instance, the IV estimate to an additional year of schooling for women only is 9 percentage points higher than the OLS estimate. The instrument improves the value of the first stage regression and the f-test on the excluded variable is significant at a 1% level. The Durbin-Wu-Hausman Chi square test confirms the need to engage in the 'corrective' procedure to deal with potential endogeneity of schooling for women only. The use of IV is warranted in the case of women only. Thus, it may be concluded that in the case of women in the Republic of Mauritius, the conventional OLS does not yield consistent estimates to social returns to schooling and that OLS estimates may be downward biased.

When the sample is split by sector of employment, the instrument predicts the schooling of private sector employees only. The IV estimate to schooling for private sector employees only is around 30 percentage points higher than the OLS estimate. But the quality tests reveal that there is a weak correlation between the free secondary education instrument and schooling. The instrument is statistically insignificant in the first stage equation and the F-test on the excluded variable is also insignificant. A similar trend can be observed in the case of public sector employees too, with the exception that the IV estimate to an extra year of schooling for the public sector workers is negative and insignificant, while only their OLS estimate is significant at the 1% level. However both the IV estimate and OLS estimate are statistically significant at a 1% level in the wage equation for private sector workers. The exogeneity test rejects the null hypothesis of no difference between the OLS and IV estimates at the 10% level of significance for this group of workers while no evidence of endogeneity is found in the case of public sector employees.

When the sector of employment is further split by gender, it can be again deduced that the instrument does not work in the case of men. It does not predict the schooling of public sector male workers and private sector male workers at all. The correlation between the 1976 free secondary education instrument and schooling for these groups is very weak. Some researchers have cautioned us against IV procedures which make use of weak instruments as these may yield more inconsistent point estimates than those produced by the conventional OLS (Bound et al, 1995; Levin & Plug, 1999). Thus in the case of the private sector male workers and public sector male workers, there is a rise in the standard errors of the estimated coefficients of schooling in the wage regressions which translates into insignificant estimates to social returns to schooling.

As far as women are concerned across these two sectors of employment, the instrument does not work for those women who are employed in the public sector. However it must be pointed out the sample size for this group of women is very small. Nevertheless the instrument works well in the case of private sector female employees. The instrument is positive and significant at 1% level in the first stage regression. The quality tests reveal that the addition of the 1976 free secondary education instrument improves the value of that equation and the f-test on the excluded variable is significant at a 1% level. The strong correlation between schooling and this instrument translates into an IV estimate which is reasonable in magnitude and significant at a 1% level. This IV estimate is around 10 percentage points higher than the OLS estimate for this group of women.

When IV estimates and OLS estimates are compared for rural areas (both sexes) and urban areas (both sexes), the IV procedure yields estimates which are 8.1 percentage points and 20 percentage points (respectively) higher than OLS estimates. Thus, OLS estimates are negatively biased which is in line with the mainstream literature. But instrumental quality has not been ensured. The correlation between the instrument and schooling is weak in both cases. The coefficients on the instrument are positive in the first stage regressions but insignificant in both cases. Although the Partial R^2 show a slight improvement in the R^2 value of the reduced form equation once the instrument is added, the F-tests on the excluded variable are insignificant in both groups of workers. Hence here the instrument does not predict schooling and one use the IV estimates. In such cases IV estimates tend to yield more inconsistent point estimates than those produced by OLS. However (with OLS estimates) it can be deduced that urban residents enjoy a higher wage premium of 4.2 percentage points than their rural counterparts which may be associated with the types of jobs and better pay scales available in urban areas. The endogeneity of residence choice is recognised and there is inconclusive evidence about the endogeneity of schooling for individuals in urban and rural areas.

Moreover the sample is split further by gender to explore potential differences in social returns to schooling due to gender, between rural and urban areas. In the case of rural men only and urban men only, the same pattern as above (as for rural residents (both sexes) and urban residents (both sexes)) is found. The instrument does not predict schooling of rural men and urban men. The correlation between the 1976 free secondary education instrument and schooling is weak in both cases. The coefficients on the instrument in the first stage regressions are insignificant in both cases and the F-tests on the excluded variable are also insignificant in both cases. The IV estimates for rural men only and urban men only are of the order 12% and 3%, respectively, but they are statistically insignificant. The Durbin-Wu-Hausman χ^2 tests on exogeneity also have insignificant coefficients for both groups.

However in the case of rural women only and urban women only, findings are different. The instrument predicts the level of schooling acquired by women in rural areas and urban areas. The coefficients on the free secondary education instrument are positive and statistically significant in the first stage regressions. The F-tests on the excluded variable for these both groups of women are statistically significant and the instrumental variable improves the R^2 values of each first stage equation. The IV estimate is 2 percentage points higher than the OLS estimate for rural women and 20 percentage points higher than the OLS estimate for urban women. These may suggest the presence of a negative bias[118] in the conventional OLS estimate of the schooling-earnings relationship, particularly large in the case of urban women. However the IV estimate to an extra year of schooling is insignificant in the case of rural women and

[118] Here IV estimates yield marginal returns to schooling for those individuals who would not have attended secondary schools in the absence of the law.

when the relevance of IV in the case of these rural women only, is assessed through the Durbin-Wu-Hausman test, there is insufficient evidence to reject the null hypothesis that the OLS estimate is consistent. Nevertheless this null hypothesis is rejected at the 5% level for urban women, implying that the IV procedure was necessary.

The next chapter summarises what has been discussed so far and also sets out some recommendations for policy makers. In short, Chapter 7 will highlight the purpose, findings and significance of this thesis.

Chapter 7: Conclusion & Policy implications

Summary of Findings

The objective of this PhD is to estimate social returns to individuals' highest academic qualification levels or vocational qualifications and also to years of schooling in the Republic of Mauritius. Although there is a rich empirical literature available on the relationship between earnings and education, this relationship in the Republic of Mauritius has not yet been studied. This has been mainly due to the absence of data on individuals' wages prior to the collection of the 2000 Population Census[119], which was the first census to include a question on income. This study is therefore able to use a nationally representative sample from the 2000 Population Census.

However the income variable used for this PhD is gross income (income from all sources and before taxation). This was the only measure of income available and only gross returns (that is social returns excluding any non-monetary benefits) to education have been estimated throughout this thesis. Although much of the other literature in this field has estimated private returns, using net income, one may argue that income before taxation acts as a better proxy for productivity. Since no data on

[119] The 2000 Population Census provides a new opportunity to estimate social returns to all academic highest qualifications and vocational qualifications in the Republic of Mauritius.

the costs of educational provision for the individuals sampled was available, the estimates are returns to education rather than a rate of return. This omission of education provision costs is standard in the Mincerian approach to estimating returns to education.

This first attempt to estimate social returns for the Republic of Mauritius attempts to tackle potentially important methodological problems such as bias due to sample selection, omitted variables and endogeneity of schooling. It also exploits a national representative data set. In the first instance, ordinary least square (OLS) estimates are obtained. I then produced estimates that correct for sample selectivity bias which arises due to individuals' non-random participation in the labour force. The problem of the possible endogeneity of schooling remains after correction for selection bias.

The 2000 Population Census data is not very rich and OLS estimation based on this data set may suffer from omitted variable bias. This is a particular concern for developing countries where data sets do not carry sufficiently detailed information about an individual, for example, the quality of school they attended, their socio-economic status and a measure of their ability. An attempt was made to correct for the omitted variable bias and the endogeneity problem via the instrumental variable approach.

The earnings regressions are presented for various groups such as both sexes, by gender, by private/ public sector and by rural/urban areas. The motivation to investigate social returns to education across these sub-groups for the Republic of Mauritius[120], emerged from the various studies which reported significant differences across gender, sector of employment and area of residence in other developing countries [for instance, Mohammad (2005) for Bangladesh, Siphambe (1997) for Bostwana and Duraisamy (2002) for India].

The sample is restricted to those who are aged 12 to 59 years, inclusive. Age 12 is the standard age for which the Central Statistics Office of the Republic of Mauritius recorded entry into the labour force and at the age of 60, people are eligible for a state pension. Of the 10,490 individuals in the random total sample available for this study, 4256 people who satisfy the age restriction and for whom all required information is available were selected. The dependent variable in the wage equations is the natural logarithm of gross hourly incomes of individuals. This variable is calculated from the reported monthly income from all sources before taxation and hours worked during the week preceding the census. Education variables include both highest academic and vocational qualifications and these enter as dummy variables in all equations which do not assume homogenous returns to education. In total, there are seven categories of educational attainment with 'no schooling at all or at most

[120] The Republic of Mauritius is a developing country.

primary schooling' being the reference group. A series of control variables such as age and tenure are also included in the models so as to account for their respective contributions to wages.

I estimate both linear and non-linear Mincerian wage equations. The former is conducted using years of schooling as the education variable and the latter uses dummy variables to indicate each level of schooling. In the case of the Republic of Mauritius, the explanatory power of all models (for both sexes, by gender, by sector and by area of residence) is quite high and is comparable to some of the literature that has estimated similar wage regressions for developing countries (Kugler & Psacharapoulos, 1989; Psacharapoulos & Steire, 1988; Al-Qudsi, 1989; Duraisamy, 2002; Siphambe, 2000). All main findings derived from the conventional OLS for the Republic of Mauritius are reported below:

- Social returns to an extra year of schooling for both sexes in the Republic of Mauritius is around 7% and this OLS estimate is highly significant.

- Rising social returns to rising academic qualification levels

  All OLS qualification coefficients are positive and significant at a 1% level. They display the expected ordering, so reflect higher wages for higher qualification levels. Thus, for the Republic of

Mauritius, there is a uniform pattern of increasing social returns to rising academic qualification levels for both sexes, by gender, by sector of employment and by rural and urban areas of residence.

- Tertiary education is the most valuable for both sexes with a social return of 120% compared to basic or no schooling, while lower secondary qualifications yield the lowest social returns of around 11% for both sexes valuable. The reference group is no schooling at all or at most primary schooling. Social returns to upper secondary, GCSE & Sixth form, A' level and vocational qualifications for both sexes are around 20%, 50%, 73% and 80%, respectively.[121]

- Women earn consistently higher social returns to all academic qualification levels as well as vocational qualifications, relative to their male counterparts. This is consistent with the existing literature which attributes this trend to the lower foregone earnings of women (Psacharopoulos & Alam, 1991; Gomez-Castellanos & Psacharapoulos, 1990; Psacharopoulos & Velez, 1994; Kugler & Psacharopoulos, 1989).

[121] When the [exp (coefficient)- 1 x100] adjustment is done to the qualification dummy coefficients so as to obtain the percentage effect of each qualification level on gross earnings (Halvorsen & Palmquist, 1978), social returns to lower secondary education, upper secondary education, GCSE & Sixth form, A level, vocational education and tertiary education for both men and women combined for the Republic of Mauritius are 12%, 22%, 64%, 107%, 122% and 235%, respectively.

- The public sector rewards low academic qualification levels relatively more, while the private sector rewards high academic qualification levels and vocational qualifications better. However the pattern of a higher wage premium attached to high academic qualification levels and vocational qualifications within the private sector, does not hold in the case of men.

- Higher social returns to all academic qualification levels and vocational qualifications are found in urban areas. This finding holds true in all cases except for those men holding A' levels from urban areas.

The problem of sample selectivity bias arises because of the use of censored data and because selection into paid work may not be random. Unobservable characteristics which affect the work decision may be correlated with the observable characteristics which affect the process determining wages and these give rise to inconsistent OLS estimates. Thus, Heckman (1979) proposed his two step selection model to deal with this problem. A selection equation is first estimated for the entire sample (labour force participants and non-participants) and the inverse of the Mills' ratio is estimated and plugged into the second stage (wage) equation. This approach has been adopted in the present study.

The Heckman selection model is estimated for each group, that is, for both sexes, by gender, by sector of employment and by area of residence. It must be noted that the same identifying variables[122] are used throughout all the groups. The dummy variables 'child' which stands for the presence of at least one child in the household, and 'married' which states the marital status of the individual, are known to be particularly important for women when they choose between work or no work (Mohammad, 2005). All findings arising from the use of the selection model are listed below:

- An extra year of schooling increases the probability of being employed by 3 percentage points for the sample of men and women combined. The coefficient for men is statistically insignificant implying that education plays a greater role in determining whether or not a woman takes up a job.

- The education variable is redefined as qualification dummy variables. All qualifications coefficients in the selection equation have positive signs and are highly significant (except for lower secondary, upper secondary and tertiary qualifications) for both sexes.

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[122] The identifying variables used in the equation for men & women combined, are gender, child, marital status and interaction terms between gender and child, gender and marital status. These were discussed in Chapter 5.

- Lower academic qualification levels do not matter for women while deciding to work or not. But higher academic qualifications significantly increase the probability of women joining the labour force. Again it is suggested that qualification levels do matter for women when deciding to work or not.

- For men all qualification coefficients are significant, except for vocational qualifications, suggesting that vocational qualification does not affect the likelihood of men being employed.

- The identifying variables 'child', 'marital status', 'gender interacted with child' and 'gender interacted with marriage' are highly significant for both sexes. As expected, being a woman reduces the chances of participating in the labour force.

- Qualifications do not seem to influence the likelihood of someone being employed in the private or public sector. All qualification coefficients are statistically insignificant for both sexes within each sector. When the impact of qualifications on the probability of being in paid work in each sector is considered separately for men and women, 'lower secondary qualification' plays a positive and significant role in the case of private sector female employees (by

25 percentage points), and upper secondary qualifications influences a man's decision to work in the private sector by 22 percentage points.

- When the chances of being in paid work is considered for rural and urban areas, the findings suggest that only those qualifications beyond GCSE & Sixth Form and vocational qualifications play significant roles (for both sexes) in increasing an individual's chances of working. The biggest impact of qualifications on the likelihood of being employed is for urban women where all qualifications (including vocational qualifications) are positive and highly significant (except in the case of upper secondary which is significant at 10%). However, a puzzling finding is that for men in rural areas with qualification levels between 'upper secondary' and 'A level', there is a significant decrease in their likelihood of being in employment. The sample size for each qualification variable is small.

- Estimates from the wage estimations adjusted for selectivity bias are somewhat similar to those generated by the conventional OLS. The selectivity term (inverse of Mills' ratio) is insignificant in most cases and in cases where they are significant (that is, for men only and rural men only), the impact on the qualifications estimates are minimal. For instance, the biggest decline reported is 7 percentage points for tertiary qualifications for urban women. Although there is evidence of selectivity bias in the case of men, conventional OLS estimates are robust to correction for sample selectivity in most cases. Adjusting for selectivity bias does not alter the expected order of social returns to education so higher social returns at higher academic qualifications levels, are obtained as previously through the conventional OLS. Also, given that there are only tiny differences between the conventional OLS estimates and those generated free of censoring bias, conventional OLS estimates may continue to be used for the Republic of Mauritius.

Apart from OLS estimates and estimates that correct for sample selectivity bias, instrumental variable (IV) estimates are also reported in this thesis. OLS estimates may be inconsistent especially in the case of omitted variable bias, measurement error and endogeneity of schooling. For the Republic of Mauritius, IV estimates are higher than the OLS estimates and this is in line with existing literature [for instance, Harmon & Walker (1995), Harmon & Walker (1999)]. It must however be pointed out that IV generates estimates that are Local Average Treatment Effect (LATE) estimates, that is, these estimates are generated for those individuals who would not have had the treatment otherwise (Angrist & Krueger, 2001).

An instrument must actually predict schooling for individuals and also have no direct relationship with earnings, i.e. the dependent variable in the second stage. IV estimates are generally obtained from two types of studies: experimental and non-experimental. Non-experimental studies focus on for instance, family background characteristics to construct instruments for education (Butcher & Case, 1994) while experimental studies focus on reforms within the education system which cause exogenous variation in school attainment such as compulsory education and change in minimum school leaving age (Angrist & Krueger, 1991; Harmon & Walker, 1995). This PhD uses an exogenous change in the educational distribution of individuals caused by a policy reform in the Republic of Mauritius in 1976 whereby secondary schooling was made free for all school-age youths. A dummy variable was defined for individuals who were born after 1958 to take a value of 1 for those who faced a regime of no fees at secondary school and 0 otherwise. This instrument is appropriate as it actually predicts schooling, especially in the case of women and has no direct association with the outcome (wages) but is sufficiently correlated to schooling[123]. It is important to note that the decision to use this instrument for this PhD has been made on the basis of theory and on the recommendations of other studies. These report that

[123] An attempt was also made to use another instrument, the 1993 basic compulsory schooling law. This was subsequently dropped from the analysis because it was insignificant in explaining school attainment. This may well be because those individuals affected by this law were still at school at the time of the census.

variables relating to institutional reforms may be good instruments to use. (Harmon & Walker, 1995; Denny & Harmon, 2000). Moreover to guard against the hazards of deriving inferences from the use of instruments that are weakly correlated with schooling, the F-statistic on the excluded instruments in the first stage schooling equation is computed, and the partial R^2 values have been reported throughout the IV chapter.

Findings arising from the IV approach are listed below:

- The quality tests show that the instrument (1976 free secondary schooling law) and schooling are satisfactorily correlated for women only and can therefore be used to generate consistent estimates in the presence of omitted variable, measurement error and endogeneity of schooling for women only. This instrument actually predicts schooling for women and this is in line with the existing literature on education for girls in the Republic of Mauritius.

- In the case of men, the instrument does not predict their schooling and one must rely on the conventional OLS estimates. I cannot provide evidence on the extent of the bias in the OLS estimates.

- IV estimates of return to schooling are significant in some cases (for women only, private sector employees only and urban women only). Most IV estimates to social returns to schooling are higher than the conventional OLS estimates. This is in line with the consensus that OLS estimates may be largely and negatively biased.

- The instrument does predict the schooling of women and the IV estimate for women is 7.7 percentage points higher than its OLS estimate. The Durbin-Wu-Hausman test suggests the need to engage in the IV procedure to deal with potential endogeneity of schooling for women, that is, OLS estimate is inconsistent.

- For women, the instrument is a good predictor of schooling for those who are in the private sector. There is a strong correlation between the 1976 free secondary education instrument and schooling for these women. The IV estimate is 10 percentage points higher than the OLS estimate for private sector female employees at 17%.

- The instrument predicts the schooling of rural and urban women well. The IV estimate is around 3 percentage points higher than the OLS estimate for rural female workers but 16 percentage points higher in the case of urban women. The IV estimate for rural female workers is around 27%, suggesting a large and negative bias in the OLS estimate for urban female workers (around 11%). However it must be pointed out that IV estimates are LATE estimates. This means they are IV yield estimates for a marginal group of the population, who would not have been affected had the policy not been implemented. These people generally have high discount rates. There is insufficient evidence in the case of rural women to reject the null hypothesis that OLS estimates are consistent but this hypothesis may be rejected at a 5% level for urban women. Thus, we should rely on the higher IV estimate but be aware it is a LATE effect.

- There is sufficient evidence to suggest that schooling is endogenous for those women who work in the private sector and who reside in urban areas. Thus, the use of IV is warranted in these cases and thus, the use of OLS estimates would be misleading.

Policy implications

From a policy perspective, information on the private and social rates of return to education is important. Rates of return studies may provide results that can act as policy indicators to government when it decides about the profitability of investing in a particular level of schooling. Specifically, the difference between social and private rates of return indicate where it is advisable for the government to increase / decrease educational subsidies. Social rates of return give the return to society when an individual completes an incremental education program, while private rates of return indicate individuals' incentives to undertake specific education programmmes (Horowitz & Schenzler, 1999). Efficiency requires social rates of return to be equated across all education levels and the same applies for the private rates of return, and also to be equal to the marginal rate of social time preference (i.e. the marginal social cost of capital). The problem is deciding what this is.

If this is not the case, potential social gains and private gains can be achieved by reallocating individuals across education levels. However, as no information is available on direct or indirect costs of education and only gross incomes are available, this study is restricted to estimating social returns to education only.

Ideally any measure of social returns to education would reflect both monetary benefits and non-monetary benefits such as externalities and non-economic benefits such as increased health awareness. It is argued that non-monetary benefits of education are potentially large (Duraisamy

& Malathy, 1990; Schultz, 1988; McMahon, 1995). However in practice, due to the difficulty of measuring these non-monetary benefits, most social return estimates are only restricted to monetary benefits (Horowitz & Schenzler, 1999). Similarly this PhD only looks at wage gains arising from educational investments. Nevertheless, in the absence of alternatives, the estimates thus obtained may act as rough indicators to policy makers in the Republic of Mauritius. These social returns will be informative if they are viewed with caution and properly interpreted. Careful comparisons of social returns across the different levels of education provide a signal of how an education system may be altered to improve efficiency.

On average the Republic of Mauritius has 9 years of schooling and social return to an additional year of schooling is around 7% for men and women combined. This estimate to social return is in line with other countries which have similar years of schooling such as in Hong Kong, Philippines, Taiwan and Venezuela - studies used by Psacharopoulos (1985). Moreover the Republic of Mauritius is an upper income country and both its average years of schooling and the associated return to education are close to the averages of 9.9 years and 7.8%, respectively for the groups of upper income countries, as provided by Psacharapoulos (1985). Additionally, social return to an extra year of schooling in the Republic of

Mauritius is similar to the estimate provided for OECD countries (Psacharopoulos & Patrinos, 2002).

However, policy makers must be aware that there is evidence of diminishing returns to schooling in the Republic of Mauritius. As discussed in Chapter 6, given its relatively higher average years of schooling, its social return to an extra year of schooling for men and women combined (7%) is lower than the mincerian returns of those countries which have lower years of schooling. In fact, it lies below the world average of 7.5 %[124] (Psacharopoulos & Patrinos, 2002).

When social returns to highest qualification levels are considered throughout the different subgroups of the sample, it is found that 'GCSE & Sixth Form', 'A level', tertiary and vocational qualifications are associated with high returns. These suggest that employers attach a high value to these qualifications which is reflected in the high wage premium. Employers attach importance to the skills acquired through these high academic qualification levels and vocational qualifications. The higher the academic qualification level, the higher is the wage premium.

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[124] The world average is 8.3 mean years of schooling with an estimated return of 7.5 % (Psacharopoulos & Patrinos, 2002). The world averages as reported by Psacharopoulos (1985) were 8.4 mean years of schooling and 10.1% return.

Due to the lack of data, private returns to education cannot be computed here. However, given that the government of the Republic of Mauritius heavily subsidies education up to tertiary level, one may expect private returns to exceed social returns at all education levels in the Mauritian context.

Social returns are highest at the tertiary level. Although no estimate to private return to education is obtained here for the Republic of Mauritius, it may be argued that private returns to tertiary education are likely to be high, given the high degree of subsidy by the government. Thus, reallocating resources within the different levels of education may not act as a disincentive for individuals to attend universities. It is suggested that some resources could be diverted away from higher education to provide quality primary education or to improve the transition rate between the primary to secondary school cycles and within the secondary school cycle. As discussed in Chapter 3, a private-aided primary school gets on average 54% of resources received by a public primary school and grants to private-aided schools have grown only at 6.4% against 8.2% for the public schools (World Bank, 2002). It has been suggested that some resources be diverted away from higher education to provide quality primary education as the benefits of primary education have been reported to be huge in the literature (Jamison & Lau, 1982; Psacharopoulos, 1989).

The resource gap between public and private aided schools is even larger at the secondary education level in the Republic of Mauritius and there is considerable scope for increasing the productive efficiency of the education system, since, as argued in Chapter 3, it is plagued by high drop out rates during the transition between the primary and secondary school cycles and within the secondary school cycle itself. Funding is also skewed against private aided secondary schools while these schools enroll more than 50% of the total secondary school population and their funding has grown at a lower rate of only 12% per annum against 35% for public schools (World Bank, 2002). The estimates of social returns to qualifications derived in this thesis reveal that social returns are high, especially at 'A' level, tertiary level and even for vocational qualifications. It is, thus, suggested that policy makers should act to improve the survival rates during the transition between the primary and secondary school cycles and within the secondary school cycle They should also provide adequate funding to private-aided secondary schools so that an increased number of students may qualify for admission into post secondary education to have access to education which is equally distributed across the population and also benefit from the high social returns associated with these high level academic qualifications ('A' level & tertiary education) and vocational qualifications.

Moreover the high social returns for tertiary education derived from the data available for this study, may be used to argue that the most recent expansion of the tertiary education system in the Republic of Mauritius has not resulted in low returns to education and therefore the country does not yet face the problem of over-expansion. Also the Skilled Biased Technology Change theory, which suggests that the demand for skills is increasing – driven up by technological change, may also explain the high social returns to higher qualification levels found in Mauritius (Machin & Reenen, 1998; Berman & Machin, 2000). Many sectors in the Republic of Mauritius have been developing at a greater pace and there have been considerable technical changes due to, for instance, the setting up of the information technological sector 'Cyberspace' which absorbs both skilled graduates and 'A' level holders.

Investment in education may help growth to happen faster especially through R&D or adapting foreign technology to local production (Gemmell, 1996). Here, investment in education helps to offset diminishing returns to both physical capital and human capital. Benhabib & Spiegel (1994) argue that it facilitates the adoption of foreign technology in developing countries and helps to create new domestic technologies in the richer countries. Tertiary education is important for countries generating new technologies or for adapting the embodied technology in physical capital. Thus, policy makers should not merely look at the high private returns and low social returns, they should also take into consideration, the level of economic and technological developments.

In the case of the Republic of Mauritius, where private rates of return are likely to be much higher than social rates of return at the tertiary level, more investment in science or engineering courses at the tertiary level may be required to generate new technologies and faster growth[125]. These are usually associated with high costs such as with the maintenance of laboratories and the purchase of specialised equipment, while some subjects such as arts and literature do not require high costs. Future rates of return analysis must not be simply used to guide the allocation of scarce resources. They must also be used along with other government objectives. Any development strategy requires human infrastructures to support it.

Card (1999) argues that IV estimation is based on an intervention that affects a narrow sub-group and this leads to an estimated return to schooling which is usually above an OLS estimator for the same sample. Nevertheless such estimates which are computed for specific subgroups remain attractive as a number of policy interventions are often directed at

[125] Due to lack of data on net incomes and costs of education, private and social rates of return calculations could not be carried out in this thesis.

them. While using the IV estimates, policy makers must be cautious as these estimates are sensitive to many factors such as model specification and assumptions made therein (Levin & Plug, 1999). The IV evidence in this PhD suggests that the 1976 free secondary education policy positively influenced the education of girls in the Republic of Mauritius. Those girls, who would have otherwise dropped out of school, did have access to secondary education and their social return to an additional year of schooling is 16% and 27% for those who live in urban areas. As discussed in Chapter 5, education increases the probability of women to be in employment. Women have been the main beneficiaries of the 1976 free secondary education policy. However very little is known about these women as data on social class and costs of education are unavailable. Yet given the cultural and economic situations prevailing at that time, the policy has indeed proved to be effective in the case of girls. Parents did not have to choose between sending their daughters or sons to school.

High social returns to all academic & vocational qualifications are obtained in urban areas. This is not surprising as urban areas usually offer better jobs and characteristically, rural areas mostly offer jobs in agriculture, forestry, mining, quarrying and the textile industries. Education is associated with a wage premium in urban areas which might, in turn, suggest under investment in education by rural residents or encourage rural residents to move out of rural areas in search of higher social returns. However due to unavailability of data on urban/rural migration and urban/rural employment rate, it is difficult to assess this issue in this thesis further. Thus, policy makers should encourage related research to be carried out.

The public sector in the Republic of Mauritius employs around 32% of total individuals in paid work (CSO, 2007). It offers permanent jobs and automatic increases in pay scales. Social returns estimated here suggest that there is a wage premium attached to high academic qualification levels and to vocational qualifications for men and women combined, who work in the private sector. This may be reflected by the relative scarcity of people with these qualifications. As presented in Chapter 4, for instance, 45% of public sector workers have 'GCSE & Sixth Form', 'A' level, tertiary and vocational qualifications, against only 17% in the private sector. It is recommended that policy makers should continue to employ qualified individuals. Also public sector workers, as discussed in Chapter 4, are on average older, have more schooling, have longer tenure and work longer hours per week compared to private sector workers. These suggest that highly qualified individuals are employed in the public sector and thus, the private sector lacks employees with adequate skills. The findings here suggest that the private sector has to revise its salaries and any work-based benefits

This study will supplement existing literature on the relationship between education and earnings, and simultaneously it is expected that it will stimulate in-depth studies which will eventually produce estimates across other subgroups such as by occupation and by level and type of degree that will take the full costs of education into account. In other words it is expected that this thesis will act as an incentive for future researchers to carry out rate of return analysis.

All estimates generated for this PhD must be interpreted carefully and must be supplemented by other information such as costs of education and taxation policy within the Republic of Mauritius, before these can be used for policy making purposes.

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Appendix A: Conventional OLS Wage Estimations

1 OLS estimates both sexes aged 12 to 59

(i) Schooling variable

Number of observations = 4256
R-squared = 0.412

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Schooling	0.070	0.003	24.81	0.000	0.065	0.076
Age	0.036	0.005	6.86	0.000	0.026	0.047
Age squared	-0.0004	0.0001	-4.96	0.000	-0.001	-0.0002
Mauritians	0.352	0.043	8.25	0.000	0.269	0.436
Public sector	0.284	0.020	14.17	0.000	0.245	0.324
Female	-0.210	0.017	-12.25	0.000	-0.244	-0.177
Rural areas	-0.091	0.016	-5.75	0.000	-0.122	-0.060
Tenure	0.023	0.003	7.87	0.000	0.017	0.028
Tenure squared	-0.0003	0.0001	-2.94	0.003	-0.0004	-0.0001
Constant	1.415	0.103	13.81	0.000	1.214	1.616

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

(ii) Qualification variables

Number of observations = 4256
R-squared = 0.465

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.112	0.023	4.90	0.000	0.067	0.157
Upper secondary	0.200	0.020	9.85	0.000	0.160	0.240
Gcse & sixthform	0.496	0.024	20.52	0.000	0.449	0.544
A level	0.727	0.034	21.37	0.000	0.660	0.794
Vocational	0.798	0.055	14.51	0.000	0.690	0.906
Tertiary	1.208	0.058	21.00	0.000	1.095	1.321
Age	0.040	0.005	7.83	0.000	0.030	0.050
Age squared	-0.0005	0.0001	-6.29	0.000	-0.001	-0.0003
Mauritians	0.333	0.037	9.02	0.000	0.261	0.406
Public sector	0.215	0.020	10.91	0.000	0.176	0.253
Female	-0.266	0.016	-16.33	0.000	-0.30	-0.234
Rural	-0.088	0.015	-5.76	0.000	-0.118	-0.058
Tenure	0.023	0.003	8.22	0.000	0.017	0.028
Tenure squared	-0.0002	0.0001	-2.92	0.004	-0.0004	-0.0001
Constant	1.863	0.099	19.48	0.000	1.676	2.051

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

2 OLS estimates for men only aged 12 to 59

(i) Schooling Variable

Number of observations = 2905
R-squared = 0.351

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Schooling	0.065	0.003	19.05	0.000	0.059	0.072
Age	0.044	0.006	6.75	0.000	0.031	0.056
Age squared	-0.0004	0.0001	-4.86	0.000	-0.001	-0.0003
Mauritians	0.220	0.059	3.75	0.000	0.105	0.336
Public sector	0.207	0.022	9.41	0.000	0.164	0.250
Rural areas	-0.065	0.018	-3.54	0.000	-0.101	-0.029
Tenure	0.017	0.003	5.13	0.000	.0107	0.024
Tenure squared	-0.0002	0.0001	-1.87	0.061	-0.0004	8.80e-06
Constant	1.471	0.124	11.82	0.000	1.227	1.715

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

(ii) Qualification variables

Number of observations = 2905
R-squared = 0.394

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.09	0.027	3.44	0.001	0.039	0.144
Upper secondary	0.178	0.024	7.55	0.000	0.132	0.225
Gcse & sixthform	0.429	0.028	15.44	0.000	0.375	0.484
A level	0.624	0.044	14.11	0.000	0.537	0.711
Vocational	0.696	0.059	11.84	0.000	0.580	0.811
Tertiary	1.079	0.074	14.63	0.000	0.935	1.224
Age	0.043	0.006	6.85	0.000	0.031	0.056
Age squared	-0.0005	0.0001	-5.18	0.000	-0.001	-0.0003
Mauritians	0.252	0.051	4.93	0.000	0.152	0.353
Public sector	0.161	0.021	7.57	0.000	0.119	0.203
Rural	-0.065	0.018	-3.63	0.000	-0.100	-0.030
Tenure	0.02	0.003	5.91	0.000	0.012	0.026
Tenure squared	-0.0002	0.0001	-2.49	0.013	-0.0004	-0.0001
Constant	1.892	0.119	15.94	0.000	1.659	2.125

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

3 OLS estimates for women only aged 12 to 59

(i) Schooling variable

Number of observations = 1351
R-squared = 0.478

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Schooling	0.075	0.005	13.82	0.000	0.064	0.086
Age	0.029	0.009	3.16	0.002	0.011	0.048
Age squared	-0.0003	0.0001	-2.24	0.025	-0.001	-0.0001
Mauritians	0.452	0.056	8.05	0.000	0.342	0.562
Public sector	0.505	0.042	12.02	0.000	0.423	0.587
Rural areas	-0.123	0.03	-4.12	0.000	-0.181	-0.064
Tenure	0.028	0.006	4.98	0.000	0.017	0.038
Tenure squared	-0.0001	0.0002	-0.48	0.629	-0.0005	0.0003
Constant	1.147	0.176	6.53	0.000	0.803	1.492

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

(ii) Qualification variables

Number of observations = 1351
R-squared = 0.548

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.164	0.044	3.71	0.000	0.077	0.251
Upper secondary	0.278	0.043	6.48	0.000	0.194	0.362
Gcse & sixthform	0.61	0.048	12.76	0.000	0.516	0.704
A level	0.85	0.058	14.64	0.000	0.736	0.964
Vocational	0.98	0.113	8.66	0.000	0.758	1.201
Tertiary	1.433	0.083	17.36	0.000	1.27	1.595
Age	0.037	0.009	4.31	0.000	0.020	0.054
Age squared	-0.0004	0.0001	-3.56	0.000	-0.001	-0.0002
Mauritians	0.429	0.055	7.74	0.000	0.320	0.538
Public sector	0.362	0.043	8.37	0.000	0.277	0.447
Rural	-0.102	0.028	-3.62	0.000	-0.157	-0.047
Tenure	0.024	0.005	4.80	0.000	0.014	0.034
Tenure squared	-0.0001	0.0002	-0.37	0.708	-0.0004	0.0003
Constant	1.481	.1603	9.24	0.000	1.167	1.796

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

4 Public sector employees aged between 12 to 59 years (both sexes)

(i) Schooling variables

Number of observations = 820
R-squared = 0.437

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Schooling	0.089	0.006	15.41	0.000	0.078	0.100
Age	0.047	0.015	3.22	0.001	0.019	0.076
Age squared	-0.001	0.0002	-2.82	0.005	-0.001	-0.0002
Mauritians	-0.626	0.074	-8.42	0.000	-0.772	-0.480
Female	0.116	0.031	3.71	0.000	0.054	0.177
Rural areas	-0.067	0.029	-2.34	0.019	-0.123	-0.011
Tenure	0.023	0.007	3.46	0.001	0.01	0.035
Tenure squared	-0.0001	0.0002	-0.69	0.492	-0.001	0.0002
Constant	2.129	0.349	6.10	0.000	1.444	2.814

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

(ii) Qualification variables

Number of observations = 820
R-squared = 0.475

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.127	0.053	2.42	0.016	0.024	0.231
Upper secondary	0.327	0.048	6.88	0.000	0.234	0.420
Gcse & Sixthform	0.547	0.039	14.12	0.000	0.471	0.623
A level	0.673	0.053	12.76	0.000	0.569	0.776
Vocational	0.762	0.062	12.33	0.000	0.641	0.884
Tertiary	1.145	0.079	14.42	0.000	0.99	1.30
Age	0.05	0.015	3.31	0.001	0.020	0.08
Age squared	-0.001	0.0002	-2.95	0.003	-0.001	-0.0002
Mauritians	-0.46	0.084	-5.50	0.000	-0.624	-0.230
Female	0.075	0.032	2.30	0.022	0.011	0.138
Rural	-0.051	0.028	-1.83	0.067	-0.106	0.004
Tenure	0.024	0.006	3.78	0.000	0.012	0.037
Tenure squared	-0.0002	0.0002	-1.02	0.310	-0.001	0.0002
Constant	2.477	0.331	7.48	0.000	1.827	3.127

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

5 Private sector employees aged between 12 to 59 years (both sexes)

(i) Schooling variables

Number of observations = 3436
R-squared = 0.299

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Schooling	0.064	0.003	19.72	0.000	0.058	0.070
Age	0.037	0.006	6.38	0.000	0.025	0.048
Age squared	-0.0004	0.0001	-4.48	0.000	-0.001	-0.0002
Mauritians	0.351	0.039	9.00	0.000	0.275	0.428
Female	-0.280	0.019	-14.50	0.000	-0.317	-0.242
Rural areas	-0.094	0.0184	-5.11	0.000	-0.130	-0.058
Tenure	0.022	0.003	6.91	0.000	0.016	0.029
Tenure squared	-0.0003	0.0001	-2.70	0.007	-0.0005	-0.0001
Constant	1.487	0.108	13.76	0.000	1.275	1.70

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

(ii) Qualification variables

Number of observations = 3436
R-squared = 0.363

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.111	0.025	4.46	0.000	0.062	0.159
Upper secondary	0.179	0.022	8.09	0.000	0.135	0.222
Gcse & sixthform	0.463	0.030	15.13	0.000	0.403	0.522
A level	0.752	0.048	15.66	0.000	0.657	0.845
Vocational	0.856	0.092	9.34	0.000	0.676	1.036
Tertiary	1.241	0.081	15.15	0.000	1.081	1.4
Age	0.042	0.006	7.48	0.000	0.031	0.053
Age squared	-0.0005	0.0001	-5.96	0.000	-0.0006	-0.0003
Mauritians	0.35	0.036	9.65	0.000	0.279	0.421
Female	-0.326	0.018	-18.08	0.000	-0.361	-0.290
Rural	-0.087	0.018	-4.88	0.000	-0.122	-0.052
Tenure	0.022	0.003	7.24	0.000	0.016	0.029
Tenure squared	-0.0003	0.0001	-2.99	0.003	-0.001	-0.0001
Constant	1.854	0.102	18.20	0.000	1.654	2.053

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

6 Private Male Employees Only

(i) Schooling variables

Number of observations = 2280
R-squared = 0.238

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Schooling	0.059	0.004	14.44	0.000	0.051	0.067
Age	0.045	0.007	6.30	0.000	0.031	0.059
Age squared	-0.001	0.0001	-4.48	0.000	-0.001	-0.0003
Mauritians	0.253	0.057	4.45	0.000	0.142	0.365
Rural areas	-0.064	0.022	-2.97	0.003	-0.108	-0.022
Tenure	0.018	0.004	4.53	0.000	0.010	0.025
Tenure squared	-0.0002	0.0001	-1.99	0.047	-0.001	-3.16e-06
Constant	1.467	0.134	10.96	0.000	1.205	1.729

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

(ii) Qualification variables

Number of observations = 2280
R-squared = 0.286

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.093	0.03	3.12	0.002	0.034	0.151
Upper secondary	0.157	0.027	5.86	0.000	0.105	0.21
Gcse & sixthform	0.387	0.037	10.57	0.000	0.315	0.459
A level	0.656	0.063	10.36	0.000	0.532	0.78
Vocational	0.722	0.095	7.60	0.000	0.536	0.909
Tertiary	1.089	0.108	10.06	0.000	0.877	1.302
Age	0.047	0.007	6.63	0.000	0.033	0.061
Age squared	-0.001	0.0001	-5.05	0.000	-0.001	-0.0003
Mauritians	0.289	0.051	5.64	0.000	0.189	0.390
Rural	-0.062	0.021	-2.93	0.003	-0.104	-0.021
Tenure	0.02	0.004	5.15	0.000	0.012	0.027
Tenure squared	-0.0003	0.0001	-2.54	0.011	-0.001	-0.0001
Constant	1.814	0.129	14.06	0.000	1.561	2.068

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

7 Private Female Employees Only

(i) Schooling variable

Number of observations = 1156
R-squared = 0.287

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Schooling	0.073	0.006	12.39	0.000	0.061	0.084
Age	0.024	0.01	2.48	0.013	0.005	0.044
Age squared	-0.0002	0.0001	-1.62	0.104	-0.001	0.0001
Mauritians	0.461	0.053	8.69	0.000	0.357	0.565
Rural areas	-0.137	0.034	-4.06	0.000	-0.203	-0.071
Tenure	0.028	0.006	4.55	0.000	0.016	0.040
Tenure squared	-0.0001	0.0002	-0.46	0.645	-0.001	0.0003
Constant	1.248	0.186	6.72	0.000	0.884	1.612

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

(ii) Qualification variables

Number of observations = 1156
R-squared = 0.395

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.151	0.045	3.31	0.001	0.061	0.24
Upper secondary	0.247	0.044	5.66	0.000	0.162	0.333
Gcse & sixthform	0.580	0.054	10.77	0.000	0.475	0.686
A level	0.895	0.076	11.74	0.000	0.745	1.044
Vocational	1.114	0.185	6.01	0.000	0.751	1.478
Tertiary	1.525	0.098	15.54	0.000	1.332	1.718
Age	0.032	0.009	3.54	0.000	0.014	0.05
Age squared	-0.0004	0.0001	-2.88	0.004	-0.001	-0.0001
Mauritians	0.453	0.059	7.64	0.000	0.336	0.57
Rural	-0.113	0.032	-3.52	0.000	-0.175	-0.05
Tenure	0.025	0.006	4.50	0.000	0.014	0.04
Tenure squared	-0.0002	0.0002	-0.88	0.378	-0.001	0.0002
Constant	1.564	0.168	9.33	0.000	1.235	1.893

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

8 Public Sector Male Employees Only

(i) Schooling variable

Number of observations = 625
R-squared = 0.398

Logarithm of gross earnings	Coefficient	Robust Std. Error	T	P>t	[95% Confidence Interval]	
Schooling	0.087	0.007	13.20	0.000	0.074	0.099
Age	0.038	0.018	2.18	0.030	0.004	0.073
Age squared	-0.0004	0.0002	-1.82	0.069	-0.001	0.00003
Mauritians	-0.680	0.073	-9.34	0.000	-0.823	-0.537
Rural areas	-0.069	0.033	-2.10	0.037	-0.134	-0.004
Tenure	0.022	0.007	3.12	0.002	0.008	0.036
Tenure squared	-0.0002	0.0002	-0.96	0.336	-0.001	0.0002
Constant	2.388	0.425	5.61	0.000	1.553	3.224

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

(ii) Qualification variables

Number of observations = 625
R-squared = 0.45

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.093	0.055	1.68	0.093	-0.016	0.202
Upper secondary	0.28	0.049	5.68	0.000	0.183	0.377
Gcse & sixthform	0.52	0.042	12.41	0.000	0.438	0.603
A level	0.643	0.062	10.42	0.000	0.521	0.764
Vocational	0.738	0.074	9.98	0.000	0.593	0.883
Tertiary	1.119	0.096	11.66	0.000	0.930	1.308
Age	0.037	0.017	2.09	0.037	0.002	0.071
Age squared	-0.0004	0.0002	-1.70	0.091	-0.001	0.0001
Mauritians	-0.488	0.097	-5.06	0.000	-0.678	-0.299
Rural	-0.063	0.032	-1.96	0.051	-0.126	0.0003
Tenure	0.026	0.007	3.70	0.000	0.012	0.039
Tenure squared	-0.0003	0.0002	-1.66	0.097	-0.001	0.0001
Constant	2.774	0.389	7.13	0.000	2.01	3.538

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

9 Public Sector Female Employees Only

(i) Schooling variable

Number of observations = 195
R-squared = 0.54

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Schooling	0.092	0.012	7.70	0.000	0.068	0.116
Age	0.069	0.031	2.25	0.026	0.008	0.129
Age squared	-0.001	0.0004	-2.13	0.034	-0.002	-0.0001
Mauritians	-0.587	0.126	-4.66	0.000	-0.836	-0.339
Rural areas	-0.029	0.060	-0.48	0.629	-0.147	0.089
Tenure	0.017	0.016	1.01	0.312	-0.016	0.049
Tenure squared	0.0004	0.0005	0.87	0.387	-0.001	0.001
Constant	1.807	0.643	2.81	0.005	0.538	3.075

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

(ii) Qualification Variables

Number of observations = 195
R-squared = 0.565

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.308	0.148	2.09	0.038	0.017	0.60
Upper secondary	0.634	0.161	3.95	0.000	0.317	0.951
Gcse & sixthform	0.659	0.119	5.53	0.000	0.424	0.894
A level	0.823	0.130	6.34	0.000	0.567	1.079
Vocational	0.90	0.130	6.90	0.000	0.642	1.157
Tertiary	1.285	0.164	7.85	0.000	0.962	1.608
Age	0.075	0.032	2.34	0.021	0.012	0.139
Age squared	-0.001	0.0004	-2.24	0.026	-0.002	-0.0001
Mauritians	-0.467	0.150	-3.12	0.002	-0.762	-0.172
Rural	0.017	0.057	0.29	0.770	-0.096	0.129
Tenure	0.019	0.015	1.26	0.209	-0.011	0.05
Tenure squared	0.0003	0.0005	0.74	0.459	-0.001	0.001
Constant	1.987	0.651	3.05	0.003	.7021	3.271

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

10 Rural Areas both sexes aged between 12 to 59 years

(i) Schooling Variable

Number of observations = 2434
R-squared = 0.388

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Schooling	0.052	0.004	14.22	0.000	0.045	0.059
Age	0.033	0.007	5.05	0.000	0.020	0.046
Age squared	-0.0004	0.0001	-3.86	0.000	-0.001	-0.0002
Mauritians	0.424	0.035	12.31	0.000	0.357	0.492
Public sector	0.322	0.026	12.45	0.000	0.271	0.373
Female	-0.264	0.022	-11.98	0.000	-0.308	-0.221
Tenure	0.023	0.004	6.34	0.000	0.016	0.030
Tenure squared	-0.0003	0.0001	-2.75	0.006	-0.001	-0.0001
Constant	1.523	0.12	12.70	0.000	1.288	1.758

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

(ii) Qualification variables

Number of observations = 2434
R-squared = 0.432

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.096	0.030	3.21	0.001	0.037	0.155
Upper secondary	0.173	0.026	6.76	0.000	0.123	0.223
Gcse & Sixthform	0.42	0.033	12.74	0.000	0.355	0.484
A level	0.73	0.053	13.69	0.000	0.625	0.835
Vocational	0.677	0.090	7.56	0.000	0.502	0.853
Tertiary	0.972	0.135	7.19	0.000	0.707	1.237
Age	0.037	0.006	5.83	0.000	0.025	0.05
Age squared	-0.0004	0.0001	-4.80	0.000	-0.001	-0.0003
Mauritians	0.318	0.033	9.69	0.000	0.254	0.382
Public sector	0.243	0.027	9.18	0.000	0.191	0.295
Female	-0.311	0.021	-14.85	0.000	-0.352	-0.27
Tenure	0.023	0.004	6.43	0.000	0.016	0.030
Tenure squared	-0.0003	0.0001	-2.59	0.010	-0.0005	-0.0001
Constant	1.906	0.112	16.95	0.000	1.686	2.127

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

11 Urban areas both sexes aged between 12 to 59 years

(i) Schooling variable

Number of observations = 1822
R-squared = 0.435

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Schooling	0.094	0.004	20.97	0.000	0.085	0.103
Age	0.042	0.009	4.83	0.000	0.025	0.058
Age squared	-0.0004	0.0001	-3.30	0.001	-0.0006	-0.0002
Mauritians	0.250	0.093	2.69	0.007	0.068	0.432
Public sector	0.253	0.032	8.01	0.000	0.191	0.315
Female	-0.173	0.026	-6.53	0.000	-0.224	-0.121
Tenure	0.020	0.005	4.30	0.000	0.011	0.029
Tenure squared	-0.0002	0.0002	-1.27	0.204	-0.0005	0.0001
Constant	1.126	0.171	6.57	0.000	.790	1.462

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

(ii) Qualification variables

Number of observations = 1822
R-squared = 0.485

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.143	0.035	4.05	0.000	0.073	0.212
Upper secondary	0.236	0.034	7.00	0.000	0.170	0.303
Gcse & sixthform	0.572	0.036	16.00	0.000	0.502	0.642
A level	0.739	0.046	16.08	0.000	0.649	0.829
Vocational	0.894	0.068	13.10	0.000	0.76	1.025
Tertiary	1.34	0.054	24.94	0.000	1.235	1.445
Age	0.044	0.008	5.15	0.000	0.028	0.060
Age squared	-0.0005	0.0001	-4.08	0.000	-0.001	-0.0002
Mauritians	0.361	0.086	4.22	0.000	0.193	0.529
Public sector	0.178	0.030	5.90	0.000	0.118	0.237
Female	-0.215	0.026	-8.39	0.000	-0.265	-0.165
Tenure	0.022	0.004	4.97	0.000	0.014	0.030
Tenure squared	-0.0002	0.0001	-1.41	0.159	-0.0005	0.0001
Constant	1.678	0.163	10.32	0.000	1.40	1.998

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

12 Rural Male employees aged between 12 to 59 years

(i) Schooling variable

Number of observations = 1699
R-squared = 0.311

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Schooling	0.053	0.005	11.49	0.000	0.044	0.062
Age	0.055	0.008	6.55	0.000	0.038	0.071
Age squared	-0.001	0.0001	-5.44	0.000	-0.001	-0.0004
Mauritians	0.364	0.043	8.42	0.000	0.28	0.449
Public sector	0.232	0.028	8.30	0.000	0.177	0.286
Tenure	0.017	0.004	3.83	0.000	0.008	0.025
Tenure squared	-0.0001	0.0001	-0.96	0.339	-0.0004	0.0001
Constant	1.257	0.148	8.51	0.000	0.967	1.546

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

(ii) Qualification variables

Number of observations = 1699
R-squared = 0.347

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.089	0.036	2.48	0.013	0.019	0.16
Upper secondary	0.145	0.031	4.68	0.000	0.084	0.206
Gcse & sixthform	0.392	0.038	10.39	0.000	0.318	0.466
A level	0.65	0.065	10.06	0.000	0.523	0.776
Vocational	0.64	0.087	7.36	0.000	0.469	0.810
Tertiary	0.806	0.159	5.07	0.000	0.494	1.118
Age	0.055	0.008	6.73	0.000	0.039	0.071
Age squared	-0.001	0.0001	-5.69	0.000	-0.001	-0.0004
Mauritians	0.334	0.044	7.60	0.000	0.248	0.42
Public sector	0.179	0.028	6.44	0.000	0.124	0.233
Tenure	0.018	0.004	4.12	0.000	0.009	0.027
Tenure squared	-0.0002	0.0001	-1.21	0.225	-0.0004	0.0001
Constant	1.623	0.143	11.33	0.000	1.342	1.904

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

13 Rural Female employees aged between 12 to 59 years

(i) Schooling variable

Number of observations = 735
R-squared = 0.416

Logarithm of gross earnings	Coefficient	Std. Error	t	P>t	[95% Confidence Interval]	
Schooling	0.049	0.007	7.32	0.000	0.036	0.063
Age	0.005	0.011	0.45	0.656	-0.017	0.027
Age squared	0.00002	0.0002	0.10	0.917	-0.0003	0.0003
Mauritians	0.424	0.055	7.70	0.000	0.316	0.532
Public sector	0.669	0.058	11.63	0.000	0.556	0.782
Tenure	0.027	0.006	4.12	0.000	0.014	0.039
Tenure squared	-0.0002	0.0002	-1.05	0.295	-0.0006	0.0002
Constant	1.695	0.199	8.49	0.000	1.303	2.087

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

(ii) Qualification Variables

Number of observations = 735
R-squared = 0.481

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.110	0.053	2.09	0.037	0.007	0.214
Upper secondary	0.256	0.052	4.91	0.000	0.154	0.359
Gcse & sixthform	0.469	0.065	7.23	0.000	0.342	0.597
A level	0.737	0.104	7.07	0.000	0.532	0.942
Vocational	0.784	0.257	3.05	0.002	0.279	1.289
Tertiary	1.412	0.181	7.79	0.000	1.06	1.768
Age	0.009	0.010	0.92	0.359	-0.011	0.03
Age squared	-0.0001	0.0001	-0.42	0.675	-0.0004	0.0002
Mauritians	0.338	0.063	5.38	0.000	0.215	0.461
Public sector	0.518	0.070	7.39	0.000	0.381	0.656
Tenure	0.026	0.006	4.29	0.000	0.014	0.038
Tenure squared	-0.0003	0.0002	-1.46	0.143	-0.001	0.0001
Constant	1.967	0.184	10.68	0.000	1.606	2.328

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

14 Urban Male employees aged between 12 to 59 years

(i) Schooling variable

Number of observations = 1206
R-squared = 0.396

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Schooling	0.081	0.005	15.78	0.000	0.071	0.091
Age	0.034	0.010	3.41	0.001	0.015	0.054
Age squared	-0.0003	0.0001	-1.87	0.061	-0.0005	0.00001
Mauritians	0.011	0.139	0.08	0.939	-0.262	0.283
Public sector	0.189	0.036	5.15	0.000	0.118	0.259
Tenure	0.017	0.005	3.15	0.002	0.006	0.027
Tenure squared	-0.0002	0.0002	-1.36	0.175	-0.0006	0.0001
Constant	1.610	0.220	7.33	0.000	1.179	2.041

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

(ii) Qualification Variables

Number of observations = 1206
R-squared = 0.445

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.108	0.040	2.69	0.007	0.029	0.187
Upper secondary	0.22	0.037	5.89	0.000	0.147	0.293
Gcse & sixthform	0.468	0.041	11.33	0.000	0.387	0.549
A level	0.589	0.061	9.73	0.000	0.470	0.708
Vocational	0.750	0.081	9.32	0.000	0.592	0.909
Tertiary	1.235	0.065	19.00	0.000	1.107	1.362
Age	0.033	0.010	3.36	0.001	0.014	0.053
Age squared	-0.0003	0.0001	-2.05	0.041	-0.0005	-0.00001
Mauritians	0.132	0.112	1.17	0.241	-0.089	0.352
Public sector	0.140	0.034	4.12	0.000	0.073	0.207
Tenure	0.021	0.005	4.19	0.000	0.011	0.031
Tenure squared	-0.0003	0.0002	-2.06	0.040	-0.001	-0.00001
Constant	2.1	0.199	10.53	0.000	1.708	2.491

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

15 Urban Female employees aged between 12 to 59 years

(i) Schooling variable

Number of observations = 616
R-squared = 0.514

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Schooling	0.112	0.009	12.11	0.000	0.094	0.131
Age	0.062	0.015	4.03	0.000	0.032	0.093
Age squared	-0.0007	0.0002	-3.22	0.001	-0.001	-0.0003
Mauritians	0.436	0.110	3.97	0.000	0.22	0.651
Public sector	0.361	0.062	5.84	0.000	0.24	0.482
Tenure	0.023	0.010	2.46	0.014	0.005	0.042
Tenure squared	0.00008	0.0003	0.25	0.803	-0.0006	0.0007
Constant	0.194	0.281	0.69	0.490	-0.357	0.7450

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

(ii) Qualification variables

Number of observations = 616
R-squared = 0.569

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.222	0.073	3.05	0.002	0.079	0.365
Upper secondary	0.272	0.075	3.63	0.000	0.125	0.419
Gcse & sixthform	0.73	0.071	10.33	0.000	0.591	0.868
A level	0.96	0.077	12.46	0.000	0.809	1.11
Vocational	1.11	0.115	9.69	0.000	0.886	1.336
Tertiary	1.513	0.097	15.68	0.000	1.324	1.703
Age	0.072	0.015	4.87	0.000	0.043	0.100
Age squared	-0.001	0.0002	-4.35	0.000	-0.001	-0.0005
Mauritians	0.601	0.115	5.14	0.000	0.376	0.826
Public sector	0.214	0.059	3.62	0.000	0.098	0.331
Tenure	0.018	0.009	2.07	0.039	0.001	0.036
Tenure squared	0.0003	0.0003	0.89	0.374	-0.0003	0.001
Constant	0.689	0.267	2.58	0.010	0.165	1.212

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

16 OLS estimates for both sexes aged 22 to 59

Number of observations = 3854
R-squared = 0.397

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Schooling	0.072	0.003	24.35	0.000	0.066	0.078
Age	0.018	0.007	2.43	0.015	0.003	0.032
Age squared	-0.0001	0.0001	-1.48	0.138	-0.0003	0.00005
Mauritians	0.385	0.044	8.77	0.000	0.30	0.470
Public sector	0.274	0.020	13.43	0.000	0.234	0.311
Female	-0.209	0.018	-11.39	0.000	-0.245	-0.173
Rural areas	-0.094	0.017	-5.60	0.000	-0.127	-0.061
Tenure	0.024	0.003	8.17	0.000	0.018	0.030
Tenure squared	-0.0003	0.0001	-3.33	0.001	-0.0005	-0.0001
Constant	1.733	0.139	12.51	0.000	1.461	2.004

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

17 OLS estimates for men only aged 22 to 59

Number of observations = 2634
R-squared = 0.318

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Schooling	0.068	0.004	18.89	0.000	0.061	0.075
Age	0.026	0.009	2.97	0.003	0.009	0.044
Age squared	-0.0002	0.0001	-1.96	0.050	-0.0005	-1.63e-07
Mauritians	0.237	0.06	3.98	0.000	0.120	0.354
Public sector	0.2001	0.022	9.01	0.000	0.157	0.244
Rural areas	-0.062	0.019	-3.21	0.001	-0.1004	-0.024
Tenure	0.019	0.003	5.34	0.000	0.012	0.025
Tenure squared	-0.0002	0.0001	-2.15	0.031	-0.0004	-0.00002
Constant	1.765	0.167	10.55	0.000	1.437	2.093

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

18 OLS estimates for women only aged 22 to 59

Number of observations = 1220
R-squared = 0.477

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Schooling	0.076	0.006	13.43	0.000	0.065	0.087
Age	0.013	0.013	1.03	0.302	-0.012	0.038
Age squared	-0.0001	0.0002	-0.61	0.542	-0.0004	0.0002
Mauritians	0.504	0.056	9.00	0.000	0.394	0.613
Public sector	0.493	0.044	11.28	0.000	0.407	0.578
Rural areas	-0.134	0.032	-4.21	0.000	-0.197	-0.072
Tenure	0.029	0.006	5.04	0.000	0.018	0.04
Tenure squared	-0.0001	0.0002	-0.68	0.494	-0.0005	0.0002
Constant	1.414	0.240	5.89	0.000	0.943	1.884

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

19 OLS estimates to qualifications for both sexes within the age range 22 to 59

Number of observations = 3854
R-squared = 0.455

Logarithm of gross earnings	Coefficient.	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.119	0.024	4.94	0.000	0.0712	0.167
Upper secondary	0.205	0.022	9.38	0.000	0.162	0.248
Gcse & sixthform	0.529	0.026	20.72	0.000	0.479	0.579
A level	0.739	0.037	20.08	0.000	0.667	0.811
Vocational	0.827	0.055	15.05	0.000	0.719	0.934
Tertiary	1.213	0.058	20.98	0.000	1.10	1.326
Age	0.026	0.007	3.74	0.000	0.012	0.040
Age squared	-0.0003	0.0001	-3.06	0.002	-0.0005	-0.0001
Mauritians	0.342	0.0376	9.11	0.000	0.268	0.416
Public sector	0.204	0.0201	10.18	0.000	0.165	0.244
Rural	-0.092	0.016	-5.69	0.000	-0.123	-0.060
Female	-0.270	0.017	-15.54	0.000	-0.305	-0.236
Tenure	0.023	0.003	8.24	0.000	0.018	0.029
Tenure squared	-0.003	0.0001	-3.13	0.002	-0.0004	-0.0001
Constant	2.121	.1312	16.16	0.000	1.863	2.377

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

20 OLS estimates to qualifications for men only within the age range 22 to 59

Number of observations = 2634
R-squared = 0.367

Logarithm of gross earnings	Coefficient.	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.101	0.028	3.63	0.000	0.0467	0.1563
Upper secondary	0.187	0.026	7.37	0.000	0.137	0.237
Gcse & sixthform	0.462	0.029	15.92	0.000	0.405	0.518
A level	0.638	0.048	13.43	0.000	0.545	0.732
Vocational	0.722	0.057	12.62	0.000	0.61	0.834
Tertiary	1.087	0.074	14.65	0.000	0.942	1.233
Age	0.029	0.009	3.30	0.001	0.012	0.046
Age squared	-0.0003	0.0001	-2.43	0.015	-0.001	-0.0001
Mauritians	0.263	0.052	5.03	0.000	0.160	0.365
Public sector	0.154	0.022	7.13	0.000	0.111	0.196
Rural	-0.062	0.019	-3.29	0.001	-0.099	-0.025
Tenure	0.020	0.003	6.00	0.000	0.014	0.027
Tenure squared	-0.0003	0.0001	-2.69	0.007	-0.001	-0.0001
Constant	2.160	0.161	13.44	0.000	1.845	2.476

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

21 OLS estimates to qualifications for women only within the age range 22 to 59

Number of observations = 1220
R-squared = 0.550

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.164	0.048	3.42	0.001	0.070	0.258
Upper secondary	0.277	0.048	5.80	0.000	0.184	0.371
Gcse & sixthform	0.643	0.052	12.43	0.000	0.541	0.744
A level	0.858	0.063	13.60	0.000	0.734	0.982
Vocational	1.028	0.116	8.86	0.000	0.800	1.256
Tertiary	1.432	0.083	17.18	0.000	1.268	1.595
Age	0.029	0.012	2.41	0.016	0.005	0.052
Age squared	-0.0003	0.0002	-2.10	0.036	-0.001	-0.00002
Mauritians	0.434	0.058	7.54	0.000	0.321	0.547
Public sector	0.354	0.045	7.90	0.000	0.266	0.441
Rural	-0.118	0.03	-3.94	0.000	-0.177	-0.059
Tenure	0.024	0.005	4.63	0.000	0.014	0.035
Tenure squared	-0.0001	0.0002	-0.45	0.651	-0.0004	0.0003
Constant	1.642	0.226	7.28	0.000	1. 2	2.086

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

22 Social returns to qualifications without the public sector variable for those aged 12 to 59 years

(i) Schooling variable

Number of observations = 4256
R-squared = 0.387

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Years of shooling	0.080	0.003	29.76	0.000	0.074	0.085
Age	0.037	0.005	7.00	0.000	0.027	0.048
Age squared	-0.0004	0.0001	-4.98	0.000	-0.0005	-0.0002
Mauritians	0.380	0.044	8.58	0.000	0.293	0.467
Female	-0.215	0.018	-12.14	0.000	-0.249	-0.180
Rural areas	-0.084	0.016	-5.21	0.000	-0.116	-0.052
Tenure	0.027	0.003	9.18	0.000	0.021	0.032
Tenure squared	-0.0003	0.0001	-2.88	0.004	-0.0004	-0.0001
Constant	1.283	0.103	12.48	0.000	1.082	1.485

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

(ii) Qualification variables

Number of observations = 4256
R-squared = 0.452

Logarithm of gross earnings	Coefficient	Robust Std. Error	t	P>t	[95% Confidence Interval]	
Lower secondary	0.119	0.023	5.17	0.000	0.074	0.164
Upper secondary	0.218	0.020	10.64	0.000	0.178	0.2587
Gcse & sixthform	0.545	0.024	23.07	0.000	0.499	0.591
A level	0.811	0.032	25.46	0.000	0.749	0.874
Vocational	0.885	0.053	16.61	0.000	0.781	0.990
Tertiary	1.286	0.057	22.39	0.000	1.174	1.399
Age	0.0415	0.005	8.05	0.000	0.031	0.0517
Age squared	-0.0005	0.0001	-6.44	0.000	-0.001	-0.0003
Mauritians	0.353	0.039	9.12	0.000	0.277	0.429
Female	-0.276	0.017	-16.68	0.000	-0.308	-0.244
Rural areas	-0.083	0.015	-5.39	0.000	-0.113	-0.053
Tenure	0.026	0.003	9.21	0.000	0.020	0.031
Tenure squared	-0.0002	0.0001	-2.84	0.005	-0.0004	-0.0001
Constant	1.807	0.097	18.69	0.000	1.618	1.997

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

23 Social returns to qualifications without the urban/rural variable for those aged 12 to 59 years

(i) Schooling variable

Number of observations = 4256
R-squared = 0.407

Logarithm of gross earnings	**Coefficient**	**Robust Std. Error**	**t**	**P>t**	**[95% Confidence Interval]**	
Years of schooling	0.073	0.003	26.59	0.000	0.068	0.079
Age	0.034	0.005	6.59	0.000	0.025	0.045
Age squared	-0.0003	0.0001	-4.60	0.000	-0.0005	-0.0002
Mauritians	0.363	0.044	8.23	0.000	0.276	0.449
Public sector	0.281	0.020	13.95	0.000	0.241	0.319
Female	-0.207	0.0173	-11.95	0.000	-0.240	-0.173
Tenure	0.023	0.0029	7.85	0.000	0.017	0.028
Tenure squared	-0.0003	0.0001	-3.01	0.003	-0.0004	-0.00009
Constant	1.338	0.102	13.16	0.000	1.139	1.537

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

(ii) Qualification variables

Number of obs = 4256
R-squared = 0.461

Logarithm of gross earnings	**Coefficient.**	**Robust Std. Error**	**t**	**P>t**	**[95% Confidence Interval]**	
Lower secondary	0.129	0.023	5.68	0.000	0.085	0.174
Upper secondary	0.210	0.020	10.44	0.000	0.171	0.251
Gcse & sixthform	0.515	0.024	21.39	0.000	0.468	0.562
A level	0.753	0.033	22.57	0.000	0.687	0.818
Vocational	0.823	0.055	14.91	0.000	0.715	0.932
Tertiary	1.243	0.058	21.61	0.000	1.131	1.356
Age	0.039	0.005	7.61	0.000	0.029	0.049
Age squared	-0.0004	0.0001	-5.99	0.000	-0.0006	-0.0003
Mauritians	0.340	0.037	9.20	0.000	0.268	0.413
Public sector	0.211	0.02	10.71	0.000	0.172	0.249
Female	-0.265	0.016	-16.10	0.000	-0.23	-0.232
Tenure	0.023	0.003	8.18	0.000	0.017	0.028
Tenure squared	-0.0003	0.0001	-2.97	0.003	-0.0004	-0.0001
Constant	1.807	0.095	19.08	0.000	1.621	1.993

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Appendix B: Heckman Selection Models

1 Both sexes within the age range: (12 to 59 years) with schooling variable

Number of observations = 7881 | Censored observations = 3625
Uncensored observations = 4256 | Wald chi2 (14) = 2879.03
Log likelihood = -6234.812 | Prob > chi2 = 0.0000

Log of gross earnings	**Coefficient**	**Std Error**	**z**	**P>z**	**[95% Confidence Interval]**	
Lower secondary	0.112	.0243	4.61	0.000	0.064	0.160
Upper secondary	0.199	.0205	9.74	0.000	0.159	0.240
Gcse & sixthform	0.493	.0225	21.94	0.000	0.449	0.537
A level	0.719	.0319	22.52	0.000	0.656	0.781
Vocational	0.788	.0457	17.23	0.000	0.698	0.877
Tertiary	1.202	.0481	25.01	0.000	1.108	1.297
Age	0.030	0.007	4.54	0.000	0.017	0.044
Age squared	-0.0003	0.0001	-3.85	0.000	-0.0005	-0.0002
Mauritians	0.367	0.052	7.11	0.000	0.266	0.468
Public	0.215	0.021	10.40	0.000	0.175	0.256
Rural	-0.088	0.015	-5.93	0.000	-0.117	-0.059
Female	-0.219	0.027	-8.19	0.000	-0.272	-0.170
Tenure	0.023	0.007	8.41	0.000	0.018	0.028
Tenure squared	-0.0003	0.0001	-2.95	0.003	-0.0004	-0.0001
Constant	2.034	0.126	16.09	0.000	1.786	2.281
Select						
Lower secondary	-0.002	0.057	-0.03	0.975	-0.113	0.109
Upper secondary	-0.036	0.050	-0.73	0.464	-0.134	0.061
Gcse + sixthform	0.133	0.054	2.47	0.013	0.027	0.238
A level	0.234	0.073	3.20	0.001	0.091	0.378
Vocational	0.403	0.131	3.07	0.002	0.146	0.661
Tertiary	0.222	0.140	1.59	0.113	-0.053	0.497
Age	0.274	0.010	28.11	0.000	0.255	0.293
Age squared	-0.003	0.0001	-25.00	0.000	-0.004	-0.003
Mauritians	-0.976	0.170	-5.75	0.000	-1.309	-0.643
Rural	0.012	0.036	0.35	0.726	-0.057	0.082
Female	-0.353	0.053	-6.62	0.000	-0.457	-0.248
Child	0.087	0.073	1.19	0.233	-0.056	0.231
Female & child	-0.090	0.088	-1.03	0.305	-0.261	0.082
Married	0.859	0.073	11.84	0.000	0.717	1.001
Female &married	-1.776	0.081	-21.88	0.000	-1.936	-1.617
Constant	-3.403	0.234	-14.53	0.000	-3.862	-2.944
Athrho	-0.152	0.070	-2.17	0.030	-0.289	-0.015
Lnsigma	-0.759	0.012	-65.87	0.000	-0.781	-0.736
Rho	-0.151	0.069			-0.282	-0.015
Sigma	0.468	0.005			0.458	0.479
Lambda	-0.071	0.032			-0.134	-0.007
LR test of independent equations (rho = 0): chi2(1) = 4.33 Prob > chi2 = 0.034						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

2 Men only within the age group of 12 to 59 years with schooling variable

Heckman selection model

Number of observations = 3980
Censored observations = 1075
Uncensored observations = 2905
Wald chi2(8) = 1181.57

Log likelihood = -3223.519

Prob > chi2 = 0.0000

Log of gross incomes	**Coefficient**	**Std. Error**	**Z**	**P>z**	**[95% Confidence Interval]**	
Years of schooling	0.065	0.003	21.11	0.000	0.059	0.071
Age	0.022	0.009	2.47	0.013	0.005	0.039
Age squared	-0.0002	0.0001	-1.55	0.120	-0.0004	0.00005
Mauritians	0.234	0.074	3.15	0.002	0.089	0.340
Public sector	0.216	0.024	9.02	0.000	0.169	0.263
Rural areas	-0.076	0.018	-4.09	0.000	-0.112	-0.039
Tenure	0.017	0.003	5.08	0.000	0.010	0.024
Tenure squared	-0.0002	0.0001	-1.83	0.067	-0.0004	0.00001
Constant	1.921	0.177	10.84	0.000	1.574	2.268
Select						
Years of schooling	-0.033	0.009	-3.44	0.001	-0.051	-0.014
Age	0.321	0.014	22.25	0.000	0.293	0.350
Age squared	-0.004	0.0002	-19.53	0.000	-0.004	-0.004
Mauritians	-0.429	0.269	-1.60	0.111	-0.956	0.098
Rural areas	0.090	0.057	1.58	0.113	-0.021	0.202
Child	0.047	0.076	0.62	0.532	-0.101	0.196
Married	0.725	0.088	8.28	0.000	0.553	0.896
Constant	-4.329	0.363	-11.93	0.000	-5.040	-3.618
Athrho	-0.329	0.093	-3.56	0.000	-0.511	-0.148
Lnsigma	-0.728	0.015	-48.52	0.000	-0.757	-0.699
Rho	-0.318	0.083			-0.470	-0.147
Sigma	0.483	0.007			0.469	0.497
Lambda	-0.154	0.041			-0.235	-0.073
LR test of independent equations (rho = 0): chi2(1) = 8.87 Prob > chi2 = 0.003						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

3 Women only within the age group 12 to 59 with schooling variable

Heckman selection model

Number of observations = 3901
Censored observations = 2550
Uncensored observations = 1351
Wald chi2(8) = 1109.34
Log likelihood = -3178.78
Prob > chi2 = 0.0000

Log of gross earnings	**Coefficient**	**Std. Error.**	**Z**	**P>z**	**[95% Confidence Interval]**	
Years of schooling	0.071	0.005	15.34	0.000	0.062	0.080
Age	0.024	0.011	2.10	0.036	0.002	0.044
Age squared	-0.0002	0.0001	-1.60	0.109	-0.0005	0.00005
Mauritians	0.501	0.084	5.97	0.000	0.336	0.665
Public sector	0.530	0.045	11.87	0.000	0.442	0.617
Rural areas	-0.132	0.030	-4.44	0.000	-0.190	-0.074
Tenure	0.027	0.006	4.90	0.000	0.016	0.038
Tenure squared	-0.0001	0.0002	-0.43	0.667	-0.0005	0.0003
Constant	1.365	0.217	6.28	0.000	0.939	1.791
Select						
Years of schooling	0.028	0.007	3.96	0.000	0.014	0.042
Age	0.249	0.013	19.28	0.000	0.224	0.275
Age squared	-0.003	0.0002	- 16.87	0.000	-0.003	-0.003
Mauritians	-1.192	0.215	-5.55	0.000	-1.613	-0.771
Rural areas	-0.043	0.046	-0.93	0.355	-0.133	0.048
Child	-0.002	0.050	-0.03	0.976	-0.100	0.097
Married	-0.879	0.060	- 14.56	0.000	-0.997	-0.761
Constant	-3.384	0.312	- 10.83	0.000	-3.996	-2.771
Athrho	-0.159	0.010	-1.59	0.113	-0.354	0.037
Lnsigma	-0.668	0.022	- 31.01	0.000	-0.710	-0.626
Rho	-0.157	0.097			-0.340	0.037
Sigma	0.513	0.011			0.492	0.535
Lambda	-0.081	0.051			-0.180	0.019
LR test of independent equations (rho = 0): chi2(1) = 2.32 Prob > chi2 = 0.128						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

4 Both sexes within the age range: (22 to 59 years) with highest qualification levels

Heckman selection model — Number of observations = 5786
Censored observations = 1932 — Uncensored observations = 3854
Wald chi2(14) = 2677.13 — Log likelihood = -5077.224
Prob > chi2 = 0.0000

Log of gross earnings	**Coefficient**	**Std. Error**	**Z**	**P>z**	**[95% ConfidenceInterval]**	
Lower secondary	0.116	0.026	4.42	0.000	0.064	0.167
Upper secondary	0.201	0.022	9.20	0.000	0.158	0.244
Gcse & sixthform	0.520	0.024	21.64	0.000	0.473	0.567
A level	0.725	0.035	21.00	0.000	0.657	0.792
Vocational	0.817	0.047	17.28	0.000	0.724	0.909
Tertiary	1.205	0.049	24.77	0.000	1.110	1.301
Age	0.023	0.007	3.31	0.001	0.009	0.037
Age squared	-0.0002	0.0001	-2.73	0.006	-0.0004	-0.0001
Mauritians	0.368	0.053	6.97	0.000	0.265	0.472
Public sector	0.205	0.021	9.69	0.000	0.163	0.246
Rural areas	-0.093	0.016	-5.92	0.000	-0.124	-0.062
Female	-0.221	0.029	-7.58	0.000	-0.278	-0.164
Tenure	0.023	0.003	8.37	0.000	0.018	0.029
Tenure squared	-0.0003	0.0001	-3.08	0.002	-0.0004	-0.0001
Constant	2.176	0.135	16.08	0.000	1.911	2.441
Select						
Lower secondary	0.146	0.069	2.10	0.036	0.010	0.282
Upper secondary	0.127	0.059	2.15	0.031	0.011	0.243
Gcse & sixthform	0.417	0.064	6.50	0.000	0.291	0.543
A level	0.573	0.095	6.05	0.000	0.388	0.759
Vocational	0.480	0.143	3.36	0.001	0.200	0.760
Tertiary	0.310	0.142	2.18	0.029	0.032	0.588
Age	0.103	0.017	6.17	0.000	0.070	0.135
Age squared	-0.001	0.0002	-5.87	0.000	-0.002	-0.0008
Mauritians	-0.762	0.176	-4.34	0.000	-1.107	-0.418
Rural areas	0.048	0.042	1.15	0.250	-0.034	0.130
Female	-0.242	0.078	-3.10	0.002	-0.395	-0.089
Child	0.133	0.090	1.48	0.139	-0.043	0.310
Female & child	-0.291	0.103	-2.81	0.005	-0.493	-0.088
Married	0.871	0.081	10.71	0.000	0.712	1.031
Female & married	-1.805	0.100	-18.05	0.000	-2.001	-1.609
Constant	-0.559	0.350	-1.60	0.110	-1.246	.1273
Athrho	-0.154	0.075	-2.07	0.038	-0.301	-0.008
Lnsigma	-0.753	0.012	-62.66	0.000	-0.776	-0.729
Rho	-0.153	0.073			-0.292	-0.008
Sigma	0.471	0.006			0.460	0.483
Lambda	-0.072	0.035			-0.140	-0.004
LR test of independent equations. (rho = 0): chi2(1) = 4.03 Prob > chi2 = 0.045						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

5 Men only within the age range: (22 to 59 years) with highest qualification levels

Heckman selection model Number of observations = 2884
(regression model with sample selection) Censored observations = 250
Uncensored observations = 2634
Wald chi2(13) = 1477.60
Log likelihood = -2412.242 Prob > chi2 = 0.0000

Log of gross earnings	**Coefficient**	**Std. Error**	**Z**	**P>z**	**[95% Confidence Interval]**	
Lower secondary	0.098	0.030	3.27	0.001	0.039	0.157
Upper secondary	0.185	0.025	7.41	0.000	0.136	0.233
Gcse & sixthform	0.456	0.028	16.17	0.000	0.401	0.512
A level	0.642	0.043	15.07	0.000	0.559	0.726
Vocational	0.725	0.055	13.16	0.000	0.617	0.833
Tertiary	1.097	0.058	18.89	0.000	0.983	1.210
Age	0.023	0.009	2.56	0.010	0.005	0.040
Age squared	-0.0002	0.0001	-1.83	0.067	-0.0004	0.00001
Mauritians	0.270	0.071	3.78	0.000	0.130	0.410
Public sector	0.153	0.023	6.54	0.000	0.107	0.200
Rural areas	-0.067	0.019	-3.57	0.000	-0.104	-0.030
Tenure	0.020	0.003	6.23	0.000	0.014	0.027
Tenure squared	-0.0003	0.0001	-2.72	0.006	-0.0005	-0.00008
Constant	2.296	0.176	13.04	0.000	1.951	2.641
Select						
Lower secondary	0.119	0.124	0.96	0.335	-0.124	0.362
Upper secondary	0.069	0.100	0.69	0.490	-0.127	0.264
Gcse & sixthform	0.270	0.122	2.22	0.026	0.032	0.508
A level	-0.090	0.144	-0.63	0.532	-0.372	0.192
Vocational	0.018	0.195	0.09	0.925	-0.365	0.401
Tertiary	-0.165	0.194	-0.85	0.394	-0.545	0.215
Age	0.077	0.029	2.60	0.009	0.019	0.134
Age squared	-0.0009	0.0004	-2.47	0.014	-0.002	-0.0002
Mauritians	-0.503	0.272	-1.85	0.065	-1.036	0.031
Rural areas	0.165	0.074	2.24	0.025	0.021	0.309
Child	0.123	0.194	1.32	0.188	-0.060	0.306
Married	0.859	0.094	9.10	0.000	0.674	1.044
Constant	-0.261	0.591	-0.44	0.659	-1.418	0.900
Athrho	-0.255	0.134	-1.90	0.057	-0.516	0.007
lnsigma	-.0776	0.015	- 50.19	0.000	-0.807	-0.746
Rho	-0.245	0.126			-0.476	0.008
Sigma	0.460	0.007			0.446	0.474
Lambda	-0.115	0.059			-0.230	0.00002
LR test of independent equations (rho = 0): chi2(1) = 2.96 Prob > chi2 = 0.0851						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

6 Women only within the age range: (22 to 59 years) with highest qualification levels

Number of observations = 2902
Censored observations = 1682
Uncensored observations = 1220
Wald chi2(13) = 1265.19
Log likelihood = -2578.322 Prob > chi2 = 0.0000

Log of gross earnings	Coefficients	Std. Error	Z	P>z	[95% Confidence Interval]	
Lower secondary	0.162	0.051	3.17	0.002	0.062	0.261
Upper secondary	0.276	0.046	6.05	0.000	0.186	0.365
Gcse & sixthform	0.634	0.045	13.96	0.000	0.545	0.723
A level	0.841	0.064	13.15	0.000	0.716	0.966
Vocational	1.012	0.090	11.24	0.000	0.835	1.189
Tertiary	1.417	0.09	15.75	0.000	1.240	1.593
Age	0.028	0.012	2.40	0.017	0.005	0.051
Age squared	-0.0003	0.0002	-2.15	0.032	-0.0006	-0.00003
Mauritians	0.453	0.083	5.45	0.000	0.290	0.617
Public sector	0.354	0.045	7.91	0.000	0.266	0.442
Rural areas	-0.118	0.029	-4.12	0.000	-0.175	-0.062
Tenure	0.024	0.005	4.60	0.000	0.014	0.035
Tenure squared	-0.00008	0.0002	-0.43	0.666	-0.0004	0.0003
Constant	1.671	0.234	7.13	0.000	1.211	2.130
Select						
Lower secondary	0.155	0.085	1.81	0.070	-0.013	0.322
Upper secondary	0.146	0.075	1.94	0.053	-0.002	0.293
Gcse & sixthform	0.457	0.075	6.09	0.000	0.310	0.605
A level	0.916	0.119	7.70	0.000	0.683	1.149
Vocational	0.793	0.193	4.10	0.000	0.414	1.172
Tertiary	0.686	0.194	3.54	0.000	0.306	1.067
Age	0.120	0.021	5.83	0.000	0.079	0.160
Age squared	-0.001	0.0003	-5.50	0.000	-0.002	-0.0009
Mauritians	-0.82	0.227	-3.60	0.000	-1.265	-0.374
Rural areas	0.011	0.051	0.21	0.834	-0.089	0.111
Child	-0.145	0.056	-2.57	0.010	-0.265	-0.034
Married	-0.929	0.066	-14.16	0.000	-1.057	-0.800
Constant	-1.126	0.447	-2.52	0.012	-2.002	-0.250
Arthrho	-0.070	0.115	-0.61	0.541	-.2949	0.155
Lnsigma	-0.747	0.021	-35.98	0.000	-0.788	-.7064643
Rho	-0.070	0.114			-0.287	.1533375
Sigma	0.474	0.010			0.455	0.493
Lambda	-0.033	0.054			-0.139	0.073
LR test of indep. eqns. (rho = 0): chi2(1) = 0.36 Prob > chi2 = 0.5458						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

7 Both sexes aged 12 to 59 years with highest qualification levels

Number of observations = 7881
Censored observations = 3625
Uncensored observations = 4256
Wald chi2(14) = 2879.03
Log likelihood = -6234.812 Prob > chi2 = 0.0000

Log of gross earnings	Coefficient	Std. Error	Z	P>z	[95% Confidence Interval]	
Lower secondary	0.112	0.024	4.61	0.000	0.065	0.16
Upper secondary	0.199	0.020	9.74	0.000	0.159	0.24
Gcse & sixth form	0.493	0.022	21.94	0.000	0.449	0.537
A level	0.719	0.032	22.52	0.000	0.656	0.781
Vocational	0.788	0.046	17.23	0.000	0.70	0.877
Tertiary	1.202	0.048	25.01	0.000	1.108	1.297
Age	0.030	0.007	4.54	0.000	0.017	0.044
Age squared	-0.0003	0.0001	-3.85	0.000	-0.001	-0.0001
Mauritians	0.367	0.052	7.11	0.000	0.266	0.468
Public sector	0.215	0.021	10.40	0.000	0.175	0.256
Rural areas	-0.088	0.015	-5.93	0.000	-0.117	-0.059
Female	-0.219	0.027	-8.19	0.000	-0.272	-0.167
Tenure	0.023	0.003	8.41	0.000	0.018	0.028
Tenure square	-0.0003	0.0001	-2.95	0.003	-0.0004	-0.0001
Constant	2.034	0.126	16.09	0.000	1.786	2.281
Select						
Lower secondary	-0.002	0.057	-0.03	0.975	-0.113	0.109
Upper secondary	-0.036	0.05	-0.73	0.464	-0.134	0.061
Gcse & sixth form	0.133	0.054	2.47	0.013	0.027	0.238
A level	0.234	0.073	3.20	0.001	0.091	0.378
Vocational	0.403	0.131	3.07	0.002	0.146	0.661
Tertiary	0.222	0.14	1.59	0.113	-0.053	0.497
Age	0.274	0.01	28.11	0.000	0.255	0.293
Age squared	-0.003	0.0001	-25.00	0.000	-0.004	-0.003
Mauritians	-0.976	0.17	-5.75	0.000	-1.309	-0.643
Rural areas	0.012	0.036	0.35	0.726	-0.057	0.082
Female	-0.353	0.053	-6.62	0.000	-0.457	-0.248
Child	0.087	0.073	1.19	0.233	-.0563	0.231
Female with child	-0.090	0.087	-1.03	0.305	-0.261	0.082
Married	0.859	0.073	11.84	0.000	0.717	1.001
Female with married	-1.776	0.081	-21.88	0.000	-1.936	-1.617
Constant	-3.403	0.234	-14.53	0.000	-3.862	-2.944
Athrho	-0.152	0.070	-2.17	0.030	-0.290	-0.015
Lnsigma	-0.759	0.012	-65.87	0.000	-0.781	-0.736
Rho	-0.151	0.069			-0.282	-0.015
Sigma	0.468	0.005			0.458	0.479
Lambda	-0.071	0.032			-0.134	-0.007
LR test of independent equations (rho = 0): chi2(1) = 4.33 Prob > chi2 = 0.038						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

8 Public sector employees with highest qualification levels.

Number of observations = 832
Censored observations = 12
Uncensored observations = 820
Wald chi2(13) = 736.37
Log likelihood = -364.4715 Prob > chi2 = 0.0000

Log of gross earnings	Coefficient	Std. Error	Z	P>z	[95% Confidence Interval]	
Lower secondary	0.120	0.056	2.14	0.032	0.01	0.23
Upper secondary	0.328	0.043	7.65	0.000	0.244	0.412
Gcse & sixthform	0.55	0.037	14.85	0.000	0.477	0.622
A level	0.675	0.049	13.78	0.000	0.579	0.771
Vocational	0.758	0.056	13.52	0.000	0.648	0.868
Tertiary	1.142	0.065	17.67	0.000	1.015	1.268
Age	0.050	0.014	3.67	0.000	0.023	0.077
Age squared	-0.001	0.0002	-3.22	0.001	-0.001	-0.0002
Mauritians	-0.362	0.263	-1.38	0.168	-0.877	0.1526
Rural areas	-0.051	0.026	-1.97	0.049	-0.103	-0.0003
Female	0.069	0.032	2.17	0.030	0.007	0.132
Tenure	0.024	0.0059	4.15	0.000	0.013	0.036
Tenure squared	-0.0002	0.0002	-1.12	0.265	-0.001	0.0001
Constant	2.366	0.382	6.20	0.000	1.618	3.114
Select						
Lower secondary	-0.682	0.571	-1.19	0.233	-1.801	0.438
Upper secondary	0.452	0.602	0.75	0.453	-0.728	1.633
Gcse & sixth form	0.627	0.55	1.14	0.254	-0.45	1.705
A level	0.349	0.514	0.68	0.497	-0.659	1.357
Vocational	0.126	0.576	0.22	0.827	-1.003	1.254
Tertiary	0.206	0.603	0.34	0.732	-0.975	1.388
Age	-0.122	0.151	-0.81	0.418	-0.418	0.174
Age squared	0.002	0.002	0.95	0.341	-0.002	0.006
Mauritians	1.892	0.906	2.09	0.037	0.115	3.668
Rural areas	-0.191	0.317	-0.60	0.548	-0.813	0.431
Female	-0.189	0.558	-0.34	0.735	-1.283	0.905
Child	-1.55	0.574	-2.70	0.007	-2.674	-0.426
Female & child	2.055	0.769	2.67	0.008	0.547	3.562
Married	1.679	0.568	2.96	0.003	0.566	2.792
Female & married	-1.991	0.749	-2.66	0.008	-3.459	-0.525
Constant	1.819	2.717	0.67	0.503	-3.507	7.144
Athrho	0.605	0.515	1.17	0.240	-0.404	1.614
Lnsigma	-1.022	0.027	-37.72	0.000	-1.076	-0.969
Rho	0.541	0.364			-0.383	0.924
Sigma	0.360	0.01			0.341	0.379
Lambda	0.194	0.133			-0.067	0.456
LR test of indep. eqns. (rho = 0): chi2(1) = 0.79 Prob > chi2 = 0.373						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

9 Private sector employees with highest qualification levels.

Heckman selection model Number of observations = 3819
(regression model with sample selection)Censored observations = 383
Uncensored observations = 3436
Wald chi2(13) = 1862.96
Log likelihood = -3505.759 Prob > chi2 = 0.0000

Log of gross earnings	**Coefficient**	**Std. Error**	**Z**	**P>z**	**[95% Confidence Interval]**	
Lower secondary	0.109	0.027	4.09	0.000	0.057	0.162
Upper secondary	0.176	0.023	7.68	0.000	0.131	0.221
Gcse & sixthform	0.460	0.027	17.01	0.000	0.407	0.513
A level	0.748	0.041	18.26	0.000	0.668	0.828
Vocational	0.86	0.065	13.15	0.000	0.732	0.989
Tertiary	1.25	0.064	19.60	0.000	1.125	1.375
Age	0.041	0.006	7.40	0.000	0.03	0.052
Age squared	-0.001	0.0001	-6.07	0.000	-0.001	-0.0004
Mauritians	0.366	0.053	6.92	0.000	0.262	0.469
Rural areas	-0.088	0.0173	-5.12	0.000	-0.122	-0.055
Female	-0.31	0.020	-15.34	0.000	-0.35	-0.271
Tenure	0.022	0.003	7.28	0.000	0.016	0.028
Tenure squared	-0.0003	0.0001	-2.93	0.003	-0.001	-0.0001
Constant	1.864	0.108	17.30	0.000	1.653	2.075
Select						
Lower secondary	0.055	0.094	0.58	0.563	-0.13	0.239
Upper secondary	0.109	0.084	1.30	0.192	-0.055	0.274
Gcse & sixth form	0.120	0.096	1.25	0.210	-0.068	0.308
A level	0.136	0.152	0.89	0.372	-0.163	0.434
Vocational	-0.05	0.213	-0.23	0.816	-0.467	0.368
Tertiary	-0.307	0.188	-1.63	0.103	-0.676	0.062
Age	0.012	0.019	0.64	0.523	-0.026	0.05
Age squared	-0.0002	0.0003	-0.59	0.555	-0.001	0.0004
Mauritians	-0.756	0.295	-2.57	0.010	-1.334	-0.179
Rural areas	0.065	0.06	1.08	0.281	-0.053	0.183
Female	0.169	0.104	1.62	0.106	-0.036	0.373
Child	0.251	0.104	2.42	0.015	0.048	0.455
Female & child	-0.457	0.134	-3.40	0.001	-0.72	-0.193
Married	0.389	0.099	3.91	0.000	0.194	0.584
Female & married	-0.95	0.133	-7.17	0.000	-1.21	-0.691
Constant	1.695	0.444	3.82	0.000	0.825	2.565
Athrho	-0.192	0.120	-1.60	0.110	-0.428	0.043
Lnsigma	-0.725	0.013	-54.20	0.000	-0.752	-0.70
Rho	-0.190	0.116			-0.404	0.043
Sigma	0.484	0.006			0.472	0.497
Lambda	-0.092	0.057			-0.203	0.019
LR test of independent equations (rho = 0): chi2(1) = 2.01 Prob > chi2 = 0.157						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

10 Private sector male employees only with highest qualification levels

Heckman selection model Number of observations = 2431
(regression model with sample selection) Censored observations =151
Uncensored observations = 2280
Wald chi2(12) = 909.72
Log likelihood = -2083.509 Prob > chi2 = 0.0000

Log of gross earnings	Coefficient	Std. Error	Z	P>z	[95% Confidence Interval]	
Lower secondary	0.094	0.032	2.98	0.003	0.032	0.156
Upper secondary	0.153	0.027	5.63	0.000	0.1	0.207
Gcse & sixthform	0.387	0.034	11.38	0.000	0.32	0.453
A level	0.654	0.053	12.30	0.000	0.55	0.759
Vocational	0.724	0.079	9.15	0.000	0.57	0.88
Tertiary	1.101	0.078	14.09	0.000	0.95	1.255
Age	0.045	0.007	6.40	0.000	0.031	0.059
Age squared	-0.0004	0.0001	-4.94	0.000	-0.0007	-0.0003
Mauritians	0.297	0.075	3.93	0.000	0.149	0.444
Rural areas	-0.0658	0.021	-3.12	0.002	-0.108	-0.024
Tenure	0.0196	0.004	5.31	0.000	0.012	0.027
Tenure squared	-0.0003	0.0001	-2.58	0.010	-0.001	-0.0001
Constant	1.853	0.141	13.14	0.000	1.577	2.130
Select						
Lower secondary	-0.073	0.122	-0.59	0.554	-0.313	0.167
Upper secondary	0.217	0.122	1.78	0.075	-0.022	0.455
Gcse & sixth form	0.061	0.141	0.44	0.663	-0.214	0.337
A level	0.115	0.226	0.51	0.610	-0.327	0.557
Vocational	-0.008	0.302	-0.03	0.978	-0.60	0.584
Tertiary	-0.367	0.246	-1.49	0.136	-0.85	0.115
Age	0.011	0.026	0.44	0.660	-0.04	0.063
Age squared	-0.0003	0.0003	-0.88	0.380	-0.001	0.0004
Mauritians	-0.697	0.428	-1.63	0.103	-1.535	0.142
Rural areas	0.170	0.085	2.01	0.044	0.004	0.336
Child	0.166	0.107	1.55	0.121	-0.044	0.376
Married	0.551	0.114	4.85	0.000	0.328	0.777
Constant	1.747	0.62	2.82	0.005	0.533	2.962
Athrho	-0.208	0.178	-1.17	0.241	-0.557	0.14
Lnsigma	-0.736	0.017	-44.62	0.000	-0.768	-0.703
Rho	-0.205	0.170			-0.505	0.139
Sigma	0.479	0.008			0.464	0.495
Lambda	-0.098	0.082			-0.260	0.063
LR test of independent equations (rho = 0): chi2(1) = 1.07 Prob > chi2 = 0.301						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

11 Public sector male employees only with highest qualification levels

Number of observations = 632
Censored observations = 7
Uncensored observations = 625
Wald chi2(12) = 510.42
Log likelihood = -265.1785 Prob > chi2 = 0.0000

Log of gross earnings	**Coefficient**	**Std. Error**	**Z**	**P>z**	**[95% Confidence Interval]**	
Lower secondary	0.096	0.059	1.62	0.104	-0.02	0.211
Upper secondary	0.281	0.045	6.22	0.000	0.192	0.37
Gcse & sixthform	0.518	0.040	12.84	0.000	0.439	0.598
A level	0.639	0.059	10.84	0.000	0.524	0.755
Vocational	0.744	0.065	11.49	0.000	0.619	0.876
Tertiary	1.130	0.077	14.62	0.000	0.979	1.282
Age	0.0378	0.017	2.22	0.026	0.0049	0.071
Age squared	-0.0004	0.0002	-1.78	0.075	-0.001	0.00004
Mauritians	-0.597	0.378	-1.58	0.114	-1.337	0.143
Rural areas	-0.063	0.030	-2.13	0.033	-.1213	-0.005
Tenure	0.025	0.007	3.75	0.000	0.012	0.038
Tenure squared	-0.0003	0.0002	-1.62	0.105	-0.001	0.0001
Constant	2.867	0.508	5.65	0.000	1.872	3.863
Select						
Lower secondary	-0.464	0.76	-0.61	0.541	-1.953	1.025
Upper secondary	0.057	0.769	0.07	0.941	-1.450	1.563
Gcse & sixthform	6.034	113641.2	0.00	1.000	-222726.5	222738.6
A level	4.966	25448.47	0.00	1.000	-49873.13	49883.06
Vocational	-0.486	0.796	-0.61	0.541	-2.047	1.074
Tertiary	-0.539	0.781	-0.69	0.490	-2.067	0.992
Age	-0.745	0.568	-1.31	0.189	-1.858	0.368
Age squared	0.010	0.008	1.25	0.210	-0.005	0.025
Mauritians	1.797	1.10	1.63	0.102	-0.358	3.951
Rural areas	-0.427	0.619	-0.69	0.491	-1.641	0.788
Child	-1.641	0.727	-2.26	0.024	-3.067	-0.216
Married	2.265	0.686	3.30	0.001	0.921	3.609
Constant	14.09	10.15	1.39	0.165	-5.799	33.978
Athrho	-0.504	0.751	-0.67	0.502	-1.978	0.968
Lnsigma	-1.024	0.029	-35.00	0.000	-1.082	-0.967
Rho	-0.465	0.589			-0.962	0.748
Sigma	0.359	0.011			0.339	0.380
Lambda	-0.167	0.213			-0.584	0.250
LR test of independent equations. (rho = 0): chi2(1) = 0.41 Prob > chi2 = 0.522						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

12 Private sector female employees only with highest qualification levels

Number of observations = 1388
Censored observations = 232
Uncensored observations = 1156
Wald chi2(12) = 750.84
Log likelihood = -1383.389 Prob > chi2 = 0.0000

Log of gross earnings	Coefficient	Std. Error	Z	P>z	[95% Confidence Interval]	
Lower secondary	0.145	0.050	2.92	0.004	0.048	0.243
Upper secondary	0.248	0.044	5.58	0.000	0.161	0.335
Gcse & sixthform	0.576	0.045	12.77	0.000	0.488	0.665
A level	0. 90	0.066	13.42	0.000	0.762	1.023
Vocational	1.120	0.114	9.86	0.000	0.897	1.343
Tertiary	1.528	0.109	14.03	0.000	1.314	1.741
Age	0.034	0.01	3.52	0.000	0.015	0.052
Age squared	-0.0004	0.0001	-2.99	0.003	-0.001	-0.0001
Mauritians	0.472	0.081	5.84	0.000	0.314	0.631
Rural areas	-0.111	0.030	-3.66	0.000	-0.171	-0.052
Tenure	0.025	0.006	4.45	0.000	0.014	0.036
Tenure squared	-0.0002	0.0002	-0.85	0.395	-0.001	0.0002
Constant	1.548	0.182	8.50	0.000	1.191	1.905
Select						
Lower secondary	0.249	0.147	1.69	0.092	-0.041	0.539
Upper secondary	0.016	0.121	0.13	0.895	-0.222	0.254
Gcse & sixth form	0.167	0.129	1.29	0.196	-0.086	0.420
A level	0.132	0.209	0.63	0.528	-0.278	0.542
Vocational	-0.118	0.299	-0.40	0.692	-0.705	0.468
Tertiary	-0.166	0.293	-0.57	0.570	-0.741	0.408
Age	0.009	0.029	0.31	0.753	-0.048	0.066
Age squared	0.00004	0.0004	0.09	0.924	-0.001	0.001
Mauritians	-0.94	0.415	-2.27	0.023	-1.752	-0.127
Rural areas	-0.042	0.087	-0.48	0.629	-0.214	.1299
Child	-0.1417	0.092	-1.53	0.125	-0.323	.0399
Married	-0.596	0.106	-5.64	0.000	-0.803	-0.389
Constant	1.954	0.658	2.97	0.003	0.665	3.244
Athrho	-0.146	0.222	-0.66	0.509	-0.581	0.288
Lnsigma	-0.73	0.024	-30.92	0.000	-0.776	-.684
Rho	-0.145	0.217			-0.524	0.281
Sigma	0.482	0.011			0.46	0.505
Lambda	-0.07	0.105			-0.277	0.137
LR test of independent equations. (rho = 0): chi2(1) = 0.31 Prob > chi2 = 0.575						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

13 Rural residents only with highest qualification levels

Number of observations = 4541
Censored observations = 2107
Uncensored observations = 2434
Wald chi2(13) =1337.83
Log likelihood = -3434.71 Prob > chi2 = 0.0000

Log of gross earnings	Coefficient	Std. Error	Z	P>z	[95% Confidence Interval]	
Lower secondary	0.098	0.032	3.02	0.003	0.034	0.161
Upper secondary	0.173	0.026	6.68	0.000	0.122	0.224
Gcse & sixthform	0.419	0.030	13.90	0.000	0.36	0.478
A level	0.726	0.046	15.81	0.000	0.64	0.816
Vocational	0.671	0.067	9.96	0.000	0.54	0.803
Tertiary	0.971	0.082	11.85	0.000	0.81	1.132
Age	0.028	0.009	3.12	0.002	0.01	0.046
Age squared	-0.0003	0.0001	-2.81	0.005	-0.001	-0.0001
Mauritians	0.349	0.064	5.49	0.000	0.224	0.473
Rural areas	0.244	0.027	8.87	0.000	0.19	0.297
Female	-0.263	0.04	-6.66	0.000	-0.3406	-0.186
Tenure	0.023	0.003	6.71	0.000	0.0163	0.03
Tenure squared	-0.0003	0.0001	-2.68	0.007	-0.001	-0.0001
Constant	2.063	0.169	12.22	0.000	1.733	2.394
Select						
Lower secondary	-0.095	0.077	-1.23	0.218	-0.247	0.056
Upper secondary	-0.092	0.065	-1.40	0.161	-0.22	0.037
Gcse & sixth form	0.016	0.075	0.22	0.827	-0.131	0.164
A level	0.136	0.108	1.26	0.208	-0.075	0.346
Vocational	0.236	0.199	1.19	0.235	-0.154	0.627
Tertiary	0.099	0.248	0.40	0.690	-0.386	0.584
Age	0.277	0.013	20.70	0.000	0.251	0.3032
Age squared	-0.003	0.0002	-18.35	0.000	-0.004	-0.003
Mauritians	-0.984	0.220	-4.47	0.000	-1.416	-0.553
Female	-0.403	0.071	-5.64	0.000	-0.542	-0.263
Child	-0.039	0.099	-0.39	0.694	-0.233	0.1548
Female &Child	-0.015	0.117	-0.13	0.895	-0.245	0.2142
Married	0.961	0.101	9.53	0.000	0.763	1.159
Female &Married	-1.906	0.112	-17.06	0.000	-2.124	-1.687
Constant	-3.329	0.312	-10.66	0.000	-3.941	-2.717
Athrho	-.149	0.105	-1.42	0.156	-0.3550	0.057
Lnsigma	-.790	0.015	-51.60	0.000	-0.82	-0.762
Rho	-.148	0.103			-0.341	0.057
Sigma	.454	0.007			0.44	0.468
Lambda	-.067	0.047			-0.159	0.0250
LR test of independent equations. (rho = 0): chi2(1) = 1.78 Prob > chi2 = 0.182						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

14 Urban residents only with highest qualification levels

Number of observations = 3340
Censored observations = 1518
Uncensored observations = 1822
Wald chi2(13) = 1362.40
Log likelihood = -2761.801 Prob > chi2 = 0.0000

Log of gross earnings	Coefficient	Std. Error	Z	P>z	[95% Confidence Interval]	
Lower secondary	0.139	0.037	3.77	0.000	0.067	0.212
Upper secondary	0.234	0.033	7.04	0.000	0.169	0.299
Gcse & sixthform	0.565	0.034	16.53	0.000	0.498	0.632
A level	0.726	0.046	15.66	0.000	0.635	0.817
Vocational	0.879	0.063	13.92	0.000	0.755	1.003
Tertiary	1.33	0.061	21.69	0.000	1.21	1.450
Age	0.033	0.010	3.30	0.001	0.0136	0.053
Age squared	-0.0003	0.0001	-2.61	0.009	-0.001	-0.0001
Mauritians	0.397	0.090	4.39	0.000	0.220	0.574
Public	0.178	0.032	5.61	0.000	0.116	0.241
Female	-0.169	0.037	-4.60	0.000	-0.242	-0.097
Tenure	0.022	0.004	4.96	0.000	0.014	0.031
Tenure squared	-0.0002	0.0001	-1.39	0.164	-0.0005	0.0001
Constant	1.867	0.193	9.67	0.000	1.488	2.245
Select						
Lower secondary	0.134	0.084	1.59	0.112	-0.031	0.298
Upper secondary	0.061	0.077	0.80	0.425	-0.090	0.212
Gcse & sixth form	0.274	0.078	3.51	0.000	0.121	0.426
A level	0.353	0.1021	3.46	0.001	0.153	0.553
Vocational	0.561	0.176	3.18	0.001	0.216	0.907
Tertiary	0.342	0.172	1.98	0.047	0.004	0.679
Age	0.269	0.014	18.65	0.000	0.24	0.30
Age squared	-0.003	0.0002	-16.63	0.000	-0.004	-0.003
Mauritians	-0.912	0.272	-3.36	0.001	-1.445	-0.371
Female	-0.30	0.081	-3.72	0.000	-0.458	-.1418
Child	0.249	0.111	2.23	0.026	0.03	0.467
Female &Child	-0.172	0.133	-1.29	0.196	-0.434	0.089
Married	0.742	0.106	6.98	0.000	0.534	0.950
Female &Married	-1.628	0.12	-13.59	0.000	-1.862	-1.393
Constant	-3.538	0.354	-9.98	0.000	-4.233	-2.843
Athrho	-.1577	0.096	-1.65	0.099	-0.345	0.030
Lnsigma	-0.731	0.018	-41.60	0.000	-0.766	-0.70
Rho	-0.156	0.093			-0.332	0.03
Sigma	0.481	0.008			0.465	0.498
Lambda	-0.075	0.045			-0.164	0.0137
LR test of independent equations. (rho = 0): chi2(1) = 2.57 Prob > chi2 = 0.109						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

15 Rural male residents only with highest qualification levels

Number of observations = 2297
Censored observations = 598
Uncensored observations = 1699
Wald chi2(12) = 719.88
Log likelihood = -1729.721 Prob > chi2 = 0.0000

Log of gross earnings	Coefficient	Std. Error	Z	P>z	[95% Confidence Interval]	
Lower secondary	0.093	0.038	2.46	0.014	0.019	0.168
Upper secondary	0.155	0.031	5.03	0.000	0.095	0.216
Gcse & sixthform	0.403	0.036	11.04	0.000	0.331	0.474
A level	0.671	0.056	12.02	0.000	0.562	0.780
Vocational	0.646	0.077	8.38	0.000	0.495	0.798
Tertiary	0.825	0.096	8.60	0.000	0.637	1.013
Age	0.025	0.010	2.40	0.016	0.005	0.0454
Age squared	-0.0003	0.0001	-2.13	0.033	-0.001	-0.00002
Mauritians	0.348	0.087	4.02	0.000	0.178	0.518
Public sector	0.174	0.030	5.64	0.000	0.113	0.234
Tenure	0.018	0.004	4.46	0.000	0.0103	0.027
Tenure squared	-0.0002	0.0001	-1.37	0.172	-0.0004	0.0001
Constant	2.215	0.207	10.78	0.000	1.812	2.618
Select						
Lower secondary	-0.145	0.123	-1.18	0.238	-0.385	0.096
Upper secondary	-0.260	0.10	-2.59	0.010	-0.456	-0.063
Gcse & sixth form	-0.245	0.122	-2.01	0.045	-0.484	-0.006
A level	-0.395	0.155	-2.54	0.011	-0.67	-0.090
Vocational	-0.257	0.257	-1.00	0.317	-0.761	0.247
Tertiary	-0.12	0.345	-0.35	0.728	-0.797	0.557
Age	0.343	0.020	16.96	0.000	0.304	0.383
Age squared	-0.004	0.0003	-15.11	0.000	-0.005	-0.004
Mauritians	-0.295	0.334	-0.88	0.376	-0.949	0.359
Child	-0.085	0.103	-0.83	0.406	-0.287	0.116
Married	0.828	0.124	6.69	0.000	0.585	1.071
Constant	-4.837	0.467	-10.36	0.000	-5.752	-3.922
Athrho	-0.467	0.109	-4.28	0.000	-0.681	-.2534
Lnsigma	-0.7740	0.020	-38.67	0.000	-0.813	-0.735
Rho	-0.436	0.088			-0.592	-0.248
Sigma	0.461	0.009			0.443	0.480
Lambda	-0.201	0.043			-0.285	-0.117
LR test of independent equations. (rho = 0): chi2(1) = 2.02 Prob > chi2 = 0.156						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

16 Urban male residents only with highest qualification levels

Number of observations = 1683
Censored observations = 477
Uncensored observations = 1206
Wald chi2(12) = 817.21
Log likelihood = -1335.841 Prob > chi2 = 0.0000

Log of gross earnings	Coefficient	Std. Error	Z	P>z	[95% Confidence Interval]	
Lower secondary	0.112	0.042	2.69	0.007	0.031	0.194
Upper secondary	0.222	0.037	6.04	0.000	0.150	0.294
Gcse & sixthform	0.474	0.040	11.71	0.000	0.40	0.554
A level	0.604	0.060	10.06	0.000	0.493	0.721
Vocational	0.754	0.075	10.00	0.000	0.606	0.901
Tertiary	1.25	0.074	16.95	0.000	1.105	1.394
Age	0.017	0.014	1.25	0.210	-0.010	0.044
Age squared	-0.0001	0.0002	-0.49	0.624	-0.0004	0.0003
Mauritians	0.160	0.127	1.26	0.208	-0.089	0.41
Public sector	0.140	0.036	3.91	0.000	0.07	0.211
Tenure	0.021	0.005	4.16	0.000	0.011	0.031
Tenure squared	-0.0003	0.0002	-1.96	0.050	-0.001	0.000
Constant	2.405	0.276	8.71	0.000	1.863	2.946
Select						
Lower secondary	-0.145	0.128	-1.13	0.259	-0.396	0.107
Upper secondary	-0.128	0.120	-1.07	0.283	-0.362	0.106
Gcse & sixthform	-0.187	0.123	-1.44	0.150	-0.442	0.067
A level	-0.451	0.158	-2.85	0.004	-0.761	-0.141
Vocational	-0.074	0.265	-0.28	0.780	-0.594	0.446
Tertiary	-0.435	0.239	-1.82	0.069	-0.903	0.034
Age	0.293	0.021	13.72	0.000	0.251	0.335
Age squared	-0.004	0.0003	-11.98	0.000	-0.004	-0.003
Mauritians	-0.584	0.468	-1.25	0.212	-1.502	0.334
Child	0.222	0.115	1.94	0.053	-0.003	0.447
Married	0.639	0.127	5.04	0.000	0.39	0.887
Constant	-3.958	0.576	-6.87	0.000	-5.087	-2.829
Athrho	-0.243	0.158	-1.54	0.125	-0.553	0.067
Lnsigma	-0.777	0.023	-34.00	0.000	-0.822	-0.732
Rho	-0.238	0.150			-0.503	0.067
Sigma	0.460	0.011			0.44	0.481
Lambda	-0.110	0.070			-0.246	0.027
LR test of independent equations. (rho = 0): chi2(1) = 2.02 Prob > chi2 = 0.156						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

17 Rural female residents only with highest qualification levels

Number of observations = 2244
Censored observations = 1509
Uncensored observations = 735
Wald chi2(12) = 660.14
Log likelihood = -1643.406 Prob > chi2 = 0.0000

Log of gross earnings	Coefficient	Std. Error	Z	P>z	[95% Confidence Interval]	
Lower secondary	0.104	0.061	1.70	0.089	-0.0156	0.224
Upper secondary	0.253	0.053	4.75	0.000	0.1485	0.357
Gcse & sixthform	0.477	0.054	8.88	0.000	0.372	0.583
A level	0.766	.088	8.66	0.000	0.592	0.939
Vocational	0.821	0.140	5.85	0.000	0.546	1.096
Tertiary	1.428	0.159	9.01	0.000	1.118	1.739
Age	0.0170	0.012	1.31	0.189	-0.008	0.042
Age squared	-0.0001	0.0002	-0.87	0.386	-0.0005	0.0002
Mauritians	0.263	0.116	2.27	0.023	0.036	0.492
Public sector	0.517	0.061	8.43	0.000	0.397	0.638
Tenure	0.026	0.006	4.14	0.000	0.014	0.038
Tenure squared	-0.0003	0.0002	-1.36	0.173	-0.001	0.0001
Constant	1.803	0.263	6.85	0.000	1.287	2.319
Select						
Lower secondary	-0.076	0.102	-0.75	0.454	-0.275	0.123
Upper secondary	-0.020	0.0876	-0.23	0.819	-0.192	0.152
Gcse & sixthform	0.134	0.095	1.41	0.160	-0.053	0.321
A level	0.498	0.145	3.42	0.001	0.212	0.783
Vocational	0.604	0.293	2.06	0.039	0.029	1.178
Tertiary	0.249	0.332	0.75	0.454	-0.403	0.90
Age	0.233	0.018	13.12	0.000	0.198	0.267
Age squared	-0.003	0.0002	-11.45	0.000	-0.003	-0.002
Mauritians	-1.293	0.287	-4.51	0.000	-1.854	-0.731
Child	-0.038	0.067	-0.57	0.568	-0.169	0.093
Married	-0.833	0.081	-10.29	0.000	-0.992	-0.674
Constant	-2.863	0.414	-6.92	0.000	-3.67	-2.052
Athrho	.1979	0.197	1.00	0.315	-0.1882	0.584
Lnsigma	-0.828	0.035	-23.65	0.000	-0.897	-0.759
Rho	0.195	0.189			-0.186	0.526
Sigma	0.437	0.015			0.408	0.468
Lambda	0.085	0.085			-0.081	0.252
LR test of independent equations. (rho = 0): chi2(1) = 1.19 Prob > chi2 = 0.275						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

18 Urban female residents only with highest qualification levels

Number of observations = 1657
Censored observations = 1041
Uncensored observations = 616
Wald chi2(12) = 515.32
Log likelihood = -1352.54 Prob > chi2 = 0.0000

Log of gross earnings	**Coefficient**	**Std. Error**	**Z**	**P>z**	**[95% Confidence Interval]**	
Lower secondary	0.208	0.073	2.84	0.004	0.065	0.352
Upper secondary	0.267	0.069	3.86	0.000	0.131	0.402
Gcse & sixthform	0.704	0.067	10.44	0.000	0.572	0.836
A level	0.915	0.089	10.26	0.000	0.740	1.09
Vocational	1.064	0.119	8.96	0.000	0.831	1.3
Tertiary	1.463	0.119	12.29	0.000	1.229	1.7
Age	0.062	0.018	3.50	0.000	0.027	0.096
Age squared	-0.001	0.0002	-3.32	0.001	-0.001	-0.0003
Mauritians	0.636	0.131	4.87	0.000	0.38	0.89
Public sector	0.217	0.062	3.50	0.000	0.096	0.338
Tenure	0.018	0.008	2.21	0.027	0.002	0.035
Tenure squared	0.0003	0.0003	0.93	0.352	-0.0003	0.0008
Constant	0.93	0.367	2.53	0.011	0.211	1.65
Select						
Lower secondary	0.325	0.113	2.87	0.004	0.103	0.547
Upper secondary	0.172	0.105	1.64	0.100	-0.033	0.378
Gcse & sixth form	0.528	0.098	5.39	0.000	0.336	0.719
A level	0.875	0.134	6.51	0.000	0.611	1.138
Vocational	0.934	0.2027	4.11	0.000	0.488	1.38
Tertiary	0.955	0.237	4.02	0.000	0.489	1.420
Age	0.255	0.0020	12.69	0.000	0.216	0.295
Age squared	-0.003	0.0003	-11.35	0.000	-0.004	-0.004
Mauritians	-0.749	0.331	-2.26	0.024	-1.398	-0.01
Child	0.08	0.079	1.01	0.314	-0.076	0.235
Married	-0.811	0.094	-8.60	0.000	-0.996	-0.627
Constant	-4.043	0.465	-8.69	0.000	-4.955	-3.132
Athrho	-0.171	0.179	-0.95	0.342	-.5220	0.181
Lnsigma	-0.701	0.034	-20.86	0.000	-0.770	-0.635
Rho	-0.169	0.174			-0.48	0.179
Sigma	0.496	0.17			0.464	0.530
Lambda	-0.084	0.088			-0.256	0.089
LR test of independent equations. (rho = 0): chi2(1) = 0.85 Prob > chi2 = 0.358						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

19 Men only with highest qualification levels aged 12 to 59

Number of observations = 3980
Censored observations = 1075
Uncensored observations = 2905
Wald chi2(13) = 1575.51
Log likelihood = -3086.615 Prob > chi2 = 0.0000

Log of gross earnings	**Coefficient**	**Std. Error**	**Z**	**P>z**	**[95% Confidence Interval]**	
Lower secondary	0.097	0.028	3.45	0.001	0.042	0.152
Upper secondary	0.185	0.0237	7.80	0.000	0.138	0.231
Gcse & sixthform	0.438	0.027	16.17	0.000	0.385	0.491
A level	0.644	0.041	15.79	0.000	0.564	0.724
Vocational	0.701	0.054	12.96	0.000	0.595	0.807
Tertiary	1.10	0.058	18.91	0.000	0.985	1.212
Age	0.018	0.008	2.19	0.028	0.001	0.034
Age squared	-.0002	0.0001	-1.41	0.159	-0.0004	0.0001
Mauritians	0.276	0.072	3.85	0.000	0.135	0.416
Public sector	0.159	.023	6.84	0.000	0.114	0.205
Rural areas	-0.070	0.018	-3.95	0.000	-0.105	-0.035
Tenure	0.020	0.003	6.19	0.000	0.014	0.026
Tenure squared	-0.0003	0.0001	-2.60	0.009	-0.0005	-0.0001
Constant	2.391	0.1649	14.50	0.000	2.069	2.715
Select						
Lower secondary	-0.159	0.088	-1.81	0.071	-0.332	0.0135
Upper secondary	-0.216	0.076	-2.82	0.005	-0.365	-0.066
Gcse & sixth form	-0.226	0.088	-2.55	0.011	-0.399	-0.052
A level	-0.43	0.11	-3.91	0.000	-0.646	-0.2142
Vocational	-0.174	0.184	-0.95	0.344	-0.534	0.186
Tertiary	-0.381	0.194	-1.97	0.049	-0.76	-0.002
Age	0.321	0.015	21.89	0.000	0.292	0.35
Age squared	-0.004	0.0002	-19.32	0.000	-0.004	-0.004
Mauritians	-0.411	0.273	-1.51	0.132	-0.946	.0123
Rural areas	0.085	0.057	1.49	0.137	-0.027	.0197
Child	0.048	0.076	0.64	0.524	-0.10	.0196
Married	0.7281	0.088	8.31	0.000	0.556	.0 90
Constant	-4.50	0.361	-12.46	0.000	-5.106	-3.790
Athrho	-0.388	0.089	-4.36	0.000	-0.56	-0.214
Lnsigma	-0.769	0.015	-50.11	0.000	-0.80	-0.738
Rho	-0.37	0.077			-0.51	-0.211
Sigma	0.464	0.007			0.45	0.478
Lambda	-0.171	0.037			-0.244	-0.10
LR test of independent equations. (rho = 0): chi2(1) = 12.95 Prob > chi2 = 0.000						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

20 Women only by highest qualifications levels aged 12 to 59

Number of observations = 3901
Censored observations = 2550
Uncensored observations = 1351
Wald chi2(13) = 1369.10
Log likelihood = -3031.668 Prob > chi2 = 0.0000

Log of gross earnings	Coefficient	Std. Error	Z	P>z	[95% Confidence Interval]	
Lower secondary	0.164	0.047	3.51	0.000	0.072	0.255
Upper secondary	0.278	0.042	6.67	0.000	0.196	0.359
Gcse & sixthform	0.608	0.042	14.52	0.000	0.526	0.69
A level	0.845	0.059	14.38	0.000	0.73	0.96
Vocational	0.973	0.087	11.17	0.000	0.803	1.144
Tertiary	1.428	0.089	16.12	0.000	1.254	1.601
Age	0.036	0.0107	3.38	0.001	0.015	0.057
Age squared	-0.0004	0.0001	-3.05	0.002	-0.0007	-0.0002
Mauritians	0.438	0.082	5.33	0.000	0.277	0.6
Public sector	0.362	0.0429	8.45	0.000	0.278	0.446
Rural areas	-0.102	0.027	-3.76	0.000	-0.155	-0.0487
Tenure	0.024	0.005	4.78	0.000	0.014	0.034
Tenure squared	-0.0001	0.0002	-0.36	0.717	-0.0004	0.0003
Constant	1.511	0.217	6.95	0.000	1.085	1.936
Select						
Lower secondary	0.088	0.075	1.17	0.241	-0.059	0.235
Upper secondary	0.050	0.067	0.75	0.451	-0.080	0.181
Gcse & sixth form	0.305	0.067	4.51	0.000	0.172	0.437
A level	0.656	0.097	6.76	0.000	0.466	0.846
Vocational	0.763	0.178	4.28	0.000	0.413	1.112
Tertiary	0.653	0.189	3.45	0.001	0.282	1.024
Age	0.244	0.013	18.47	0.000	0.217	0.269
Age squared	-0.003	0.0002	-16.32	0.000	-0.003	-0.003
Mauritians	-1.09	0.212	-5.13	0.000	-1.505	-0.673
Rural areas	-0.008	0.046	-0.18	0.854	-0.099	0.082
Child	0.007	0.051	0.13	0.893	-0.093	0.1069
Married	-0.829	0.061	-13.61	0.000	-0.949	-0.71
Constant	-3.328	0.309	-10.78	0.000	-3.933	-2.723
Athrho	-0.027	0.128	-0.21	0.834	-0.278	0.224
Lnsigma	-0.762	0.019	-39.34	0.000	-0.799	-0.723
Rho	-0.027	0.128			-0.271	0.221
Sigma	0.467	0.009			0.45	0.49
Lambda	-0.012	0.060			-0.12	0.105
LR test of independent. equations. (rho = 0): chi2(1) = 0.04 Prob > chi2 = 0.835						

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Appendix C: Instrumental variable approach

1. IV procedure using the instrument 'basic compulsory education' for both sexes

First-stage regression of Schooling:
Ordinary Least Squares (OLS) regression

Number of observations = 4256
F(9, 4246) = 124.20
Prob > F = 0.0000

Centered R2 = 0.2084
Uncentered R2 = 0.9000

Schooling	Coefficient	Std. Error	t	P>t	[95% Confidence Interval]	
Age	0.155	0.039	3.99	0.000	0.079	0.231
Age squared	-0.004	0.001	-6.98	0.000	-0.005	-0.001
Tenure	-0.019	0.018	-1.06	0.288	-0.055	0.016
Tenure squared	0.0007	0.001	1.23	0.219	-0.0004	0.002
Mauritian	-1.231	0.328	-3.75	0.000	-1.873	-0.588
Public sector	2.620	0.130	20.09	0.000	2.364	2.876
Rural areas	-1.445	0.097	-14.88	0.000	-1.639	-1.257
Female	-0.066	0.106	-0.63	0.531	-.273	0.141
Basic compulsory education	-1.4149	0.293	-4.82	0.000	-1.989	-0.84
Constant	10.386	0.748	13.89	0.000	8.92	11.851

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Partial R-squared of excluded instruments: 0.0055

Test of excluded instruments:

F(1, 4246) = 23.28

Prob > F = 0.0000

Summary results for first-stage regressions:

Variable	Shea Partial R2	Partial R2	F(1, 4246)	P-value
Schooling	0.0055	0.0055	23.28	0.0000

Instrumental variables (2SLS) regression

Number of observations = 4256

F(9, 4246) = 200.64

Prob > F = 0.0000

Centered R2 = 0.3059

Uncentered R2 = 0.9750

Logarithm of gross earnings	**Coefficient**	**Std. Error**	z	**P>z**	**[95% Confidence Interval]**	
Schooling	0.136	0.035	3.88	0.000	0.067	0.205
Age	0.02	0.010	1.92	0.055	-0.0004	0.040
Age squared	-0.0001	0.0002	-0.31	0.759	-0.0004	0.0003
Tenure	0.024	0.003	7.60	0.000	0.018	0.031
Tenure squared	-0.0003	0.0001	-3.11	0.002	-0.0005	-0.0001
Mauritian	0.441	0.073	6.06	0.000	0.298	0.583
Public sector	0.110	0.095	1.16	0.248	-0.077	0.297
Rural areas	0.005	0.054	0.09	0.926	-0.100	0.110
Female	-0.206	0.018	-11.43	0.000	-0.242	-0.171
Constant	0.839	0.326	2.57	0.010	0.199	1.478

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Sargan statistic (overidentification test of all instruments): 0.000

(equation exactly identified)

Tests of endogeneity of: Schooling

H_0: Regressor is exogenous

Wu-Hausman F test: 4.19445 F(1,4245) P-value = 0.04062

Durbin-Wu-Hausman chi-sq test: 4.20117 Chi-sq(1) P-value = 0.04040

2. IV procedure using the instrument 'free secondary education' for both sexes

First-stage regression of Schooling:

Ordinary Least Squares (OLS) regression

Number of observations = 4256

F(9, 4246) = 124.20

Prob > F = 0.0000

Centered R2 = 0.2084

Uncentered R2 = 0.9000

Schooling	Coefficient	Std. Error	t	P>t	[95% Confidence Interval]	
Age	0.222	0.036	6.11	0.000	0.151	0.293
Age squared	-0.004	0.001	-7.83	0.000	-0.005	-0.003
Tenure	-0.023	0.018	-1.25	0.212	-0.059	0.013
Tenure squared	0.001	0.001	1.46	0.143	-0.0003	0.002
Mauritian	-1.349	0.328	-4.11	0.000	-1.992	-0.706
Public sector	2.646	0.131	20.22	0.000	2.389	2.902
Rural areas	-1.453	0.098	-14.90	0.000	-1.644	-1.26
Female	-0.064	0.106	-0.60	0.547	-0.271	0.144
Free secondary schooling	0.395	0.210	1.88	0.060	-0.017	0.806
Constant	8.606	0.667	12.93	0.000	7.301	9.911

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Partial R-squared of excluded instruments: 0.0008

Test of excluded instruments:

F(1, 4246) = 3.53

Prob > F = 0.0603

Summary results for first-stage regressions:

Variable	Shea Partial R2	Partial R2	F(1, 4246)	P-value
Schooling	0.0008	0.0008	3.53	0.0603

Instrumental variables (2SLS) regression

Number of observations = 4256

F(9, 4246) = 200.64

Prob > F = 0.0000

Centered R2 = 0.3059 Uncentered R2 = 0.9750

Logarithm of gross earnings	**Coefficient**	**Std. Error**	**z**	**P>z**	**[95% Confidence Interval]**	
Schooling	.1900837	.1046157	1.82	0.069	-.0149593	.3951267
Age	.0066894	.0267133	0.25	0.802	-.0456677	.0590465
Age squared	.0001978	.0005033	0.39	0.694	-.0007886	.0011842
Tenure	.0256893	.0044078	5.83	0.000	.0170501	.0343285
Tenure squared	-.0003658	.0001457	-2.51	0.012	-.0006514	-.0000801
Mauritian	.5124609	.1538706	3.33	0.001	.21088	.8140417
Public sector	-.031396	.2765401	-0.11	0.910	-.5734047	.5106127
Rural areas	.0829908	.1530578	0.54	0.588	-.2169971	.3829786
Female	-.2029316	.0217367	-9.34	0.000	-.2455348	-.1603285
Constant	.370897	.9203235	0.40	0.687	-1.432904	2.174698

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Sargan statistic (overidentification test of all instruments): 0.000

(equation exactly identified)

Tests of endogeneity of: Schooling

H_0: Regressor is exogenous

Wu-Hausman F test: 2.08765 F(1,4245) P-value = 0.14857

Durbin-Wu-Hausman chi-sq test:2.09203 Chi-sq(1) P-value = 0.14807

3. IV procedure using the instrument 'free secondary education' for men only

First-stage regression of Schooling:

Ordinary Least Squares (OLS) regression

Number of observations = 2905

F(8, 2896) = 49.26

Prob > F = 0.0000

Centered R2 = 0.1198

Uncentered R2 = 0.9055

Schooling	**Coefficient**	**Std. Error**	**t**	**P>t**	**[95% Confidence Interval]**	
Age	0.204	0.043	4.72	0.000	0.119	0.289
Age squared	-0.003	0.001	-5.44	0.000	-0.005	-0.002
Tenure	-0.017	0.021	-0.81	0.418	-0.059	0.024
Tenure squared	-0.0002	0.001	-0.24	0.810	-0.001	0.001
Mauritian	0.991	0.464	2.13	0.033	0.081	1.902
Public sector	2.088	0.147	14.18	0.000	1.799	2.377
Rural areas	-1.014	0.115	-8.85	0.000	-1.238	-0.789
Free secondary schooling	-0.032	0.242	-0.13	0.894	-0.506	0.442
Constant	6.232	0.830	7.51	0.000	4.605	7.86

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Partial R-squared of excluded instruments: 0.0000

Test of excluded instruments:

F(1, 2896) = 0.02

Prob > F = 0.8941

Summary results for first-stage regressions:

Variable	Shea Partial R2	Partial R2	F(1, 2896)	P-value
Schooling	0.0000	0.0000	0.02	0.8941

Instrumental variables (2SLS) regression

Number of observations = 2905

F(8, 2896) = 110.34

Prob > F = 0.0000

Centered R2 = 0.2234

Uncentered R2 = 0.9775

Logarithm of gross earnings	**Coefficient**	**Std. Error**	**z**	**P>z**	**[95% Confidence Interval]**	
Schooling	0.135	1.282	0.10	0.916	-2.378	2.647
Age	0.03	0.259	0.11	0.909	-0.478	0.537
Age squared	-0.0002	0.004	-0.05	0.963	-0.009	0.008
Tenure	0.019	0.022	0.84	0.401	-0.025	0.062
Tenure squared	-0.0002	0.0002	-0.77	0.441	-0.001	0.0003
Mauritian	0.152	1.271	0.12	0.905	-2.339	2.643
Public sector	0.063	2.678	0.02	0.981	-5.186	5.311
Rural areas	0.005	1.300	0.00	0.997	-2.543	2.554
Constant	1.041	7.98	0.13	0.896	-14.599	16.680

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Sargan statistic (overidentification test of all instruments): 0.000

(equation exactly identified)

Tests of endogeneity of: Schooling

H_0: Regressor is exogenous

Wu-Hausman F test: 0.00347 F(1,2895) P-value = 0.95304

Durbin-Wu-Hausman chi-sq test:0.00348 Chi-sq(1) P-value = 0.95296

4. IV procedure using the instrument 'free secondary education' for women only

First-stage regression of Schooling:

Ordinary Least Squares (OLS) regression

Number of observations = 1351

F(8, 1342) = 117.54

Prob > F = 0.0000

Centered R2 = 0.4120

Uncentered R2 = 0.9027

Schooling	**Coefficient**	**Std. Error**	**t**	**P>t**	**[95% Confidence Interval]**	
Age	0.179	0.063	2.83	0.005	0.055	0.304
Age squared	-0.004	0.001	-4.35	0.000	-0.006	-0.002
Tenure	-0.010	0.034	-0.30	0.768	-0.077	0.057
Tenure squared	0.001	0.001	0.55	0.586	-0.002	0.003
Mauritian	-3.149	0.450	-7.00	0.000	-4.032	-2.267
Public sector	3.77	0.257	14.68	0.000	3.266	4.273
Rural areas	-2.128	0.172	-12.35	0.000	-2.466	-1.790
Free secondary schooling	1.236	0.387	3.20	0.001	0.478	1.995
Constant	11.171	1.088	10.27	0.000	9.037	13.305

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Partial R-squared of excluded instruments: 0.0076

Test of excluded instruments:

F(1, 1342) = 10.22

Prob > F = 0.0014

Summary results for first-stage regressions:

Variable	Shea Partial R2	Partial R2	F(1, 1342)	P-value
Schooling	0.0076	0.0076	10.22	0.0014

Instrumental variables (2SLS) regression

Number of observations = 1351

F(8, 1342) = 95.51

Prob > F = 0.0000

Total (centered) SS = 651.8345472 Centered R2 = 0.3561

Total (uncentered) SS = 13589.10886 Uncentered R2 = 0.9691

Logarithm of gross earnings	**Coefficient**	**Std. Error**	**Z**	**P>z**	**[95% Confidence Interval]**	
Schooling	0.152	0.056	2.74	0.006	0.043	0.261
Age	0.009	0.018	0.51	0.608	-0.026	0.044
Age squared	0.0001	0.0004	0.43	0.670	-0.001	0.001
Tenure	0.029	0.006	4.69	0.000	0.017	0.041
Tenure squared	-0.0002	0.0002	-0.74	0.462	-0.001	0.0003
Mauritian	0.694	0.191	3.63	0.000	0.319	1.069
Public sector	0.215	0.213	1.01	0.313	-0.202	0.633
Rural areas	0.043	0.123	0.35	0.727	-0.198	0.284
Constant	0.261	0.665	0.39	0.695	-1.043	1.566

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Sargan statistic (overidentification test of all instruments): 0.000

(equation exactly identified)

Tests of endogeneity of: Schooling

H_0: Regressor is exogenous

Wu-Hausman F test: 2.39174 F(1,1341) P-value = 0.12221

Durbin-Wu-Hausman chi-sq test: 2.40528 Chi-sq(1) P-value = 0.12093

5. IV procedure using the instrument 'free secondary education' for private sector employees only (both sexes)

First-stage regression of Schooling:

Ordinary Least Squares (OLS) regression

Number of observations = 3436

F(8, 3427) = 75.72

Prob > F = 0.0000

Centered R2 = 0.1502

Uncentered R2 = 0.8889

Schooling	Coefficient	Std. Error	T	P>t	[95% Confidence Interval]	
Age	0.243	0.040	6.08	0.000	0.164	0.321
Age squared	-0.004	0.001	-7.36	0.000	-0.006	-0.003
Tenure	-0.029	0.020	-1.44	0.150	-0.069	0.011
Tenure squared	0.001	0.0006	1.67	0.096	-0.0002	0.002
Mauritian	-1.403	0.335	-4.19	0.000	-2.059	-0.746
Rural areas	-1.599	0.110	-14.58	0.000	-1.814	-1.384
Female	-0.299	0.117	-2.56	0.011	-0.528	-0.070
Free secondary schooling	0.247	0.247	1.00	0.318	-0.238	0.732
Constant	8.537	0.699	12.20	0.000	7.165	9.908

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Partial R-squared of excluded instruments: 0.0003

Test of excluded instruments:

F(1, 3427) = 1.00

Prob > F = 0.3175

Summary results for first-stage regressions:

Variable	Shea Partial R2	Partial R2	F(1, 3427)	P-value
Schooling	0.0003	0.0003	1.00	0.3175

Instrumental variables (2SLS) regression

Number of observations = 3436

F(8, 3427) = 29.42

Prob > F = 0.0000

Total (centered) SS = 1252.875221 Centered R2 = -1.7214

Total (uncentered) SS = 35853.7673 Uncentered R2 = 0.9049

Logarithm of gross earnings	**Coefficient**	**Std. Error**	**z**	**P>z**	**[95% Confidence Interval]**	
Schooling	0.336	0.315	1.07	0.287	-0.282	0.953
Age	-0.034	0.083	-0.41	0.682	-0.195	0.128
Age squared	0.001	0.002	0.61	0.539	-0.002	0.004
Tenure	0.030	0.011	2.69	0.007	0.008	0.053
Tenure squared	-0.001	0.0004	-1.43	0.153	-0.001	0.0002
Mauritian	0.73	0.452	1.62	0.106	-0.155	1.615
Rural areas	0.34	0.505	0.67	0.500	-0.649	1.329
Female	-0.199	0.101	-1.97	0.049	-0.396	-0.001
Constant	-0.843	2.711	-0.31	0.756	-6.157	4.47

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Sargan statistic (overidentification test of all instruments): 0.000

(equation exactly identified)

Tests of endogeneity of: Schooling

H_0: Regressor is exogenous

Wu-Hausman F test: 2.87923 F(1,3426) P-value = 0.08982

Durbin-Wu-Hausman chi-sq test: 2.88521 Chi-sq(1) P-value = 0.08940

6. IV procedure using the instrument 'free secondary education' for Public sector employees only (both sexes)

First-stage regression of Schooling:

Ordinary Least Squares (OLS) regression

Number of observations = 820

F(8, 811) = 34.23

Prob > F = 0.0000

Centered R2 = 0.2524

Uncentered R2 = 0.9354

Schooling	**Coefficient**	**Std. Error**	**t**	**P>t**	**[95% Confidence Interval]**	
Age	-0.067	0.110	-0.61	0.543	-0.282	0.149
Age squared	-0.001	0.001	-0.92	0.359	-0.004	0.001
Tenure	0.035	0.048	0.73	0.464	-0.059	0.129
Tenure squared	0.0001	0.001	0.05	0.957	-0.003	0.003
Mauritian	-4.708	2.104	-2.24	0.026	-8.837	-0.579
Rural areas	-0.815	0.209	-3.90	0.000	-1.226	-0.405
Female	1.01	0.25	4.05	0.000	0.520	1.500
Free secondary schooling	0.437	0.389	1.12	0.262	-0.327	1.201
Constant	19.975	3.064	6.52	0.000	13.962	25.988

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Partial R-squared of excluded instruments: 0.0016

Test of excluded instruments:

F(1, 811) = 1.26

Prob > F = 0.2618

Summary results for first-stage regressions:

Variable	Shea Partial R2	Partial R2	F(1, 811)	P-value
Schooling	0.0016	0.0016	1.26	0.2618

Instrumental variables (2SLS) regression

Number of observations = 820

F(8, 811) = 17.55

Prob > F = 0.0000

Total (centered) SS = 199.0376318   Centered R2 = 0.0736

Total (uncentered) SS = 12180.09113   Uncentered R2 = 0.9849

Residual SS = 184.391959   Root MSE = .47

Logarithm of gross earnings	**Coefficient**	**Std. Error**	**z**	**P>z**	**[95% Confidence Interval]**	
Schooling	-0.013	0.144	-0.09	0.928	-0.296	.2699
Age	0.042	0.02	2.11	0.035	0.003	0.08
Age squared	-0.001	0.0003	-2.10	0.036	-0.001	-.00004
Tenure	0.026	0.009	2.85	0.004	0.008	0.044
Tenure squared	-0.0001	0.0002	-0.52	0.601	-0.0005	0.0003
Mauritian	-1.112	0.768	-1.45	0.147	-2.618	0.393
Rural areas	-0.15	0.122	-1.23	0.219	-0.389	0.089
Female	0.22	0.153	1.44	0.150	-0.08	0.52
Constant	4.222	3.003	1.41	0.160	-1.663	10.108

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Sargan statistic (overidentification test of all instruments): 0.000

(equation exactly identified)

Tests of endogeneity of: Schooling

H_0: Regressor is exogenous

Wu-Hausman F test: 0.81354 F(1,810) P-value = 0.36734

Durbin-Wu-Hausman chi-sq test: 0.82276 Chi-sq(1) P-value = 0.36438

7. IV procedure using the instrument 'free secondary education' for private sector male employees only

First-stage regression of Schooling:

Ordinary Least Squares (OLS) regression

Number of observations = 2280

F(7, 2272) = 24.90

Prob > F = 0.0000

Centered R2 = 0.0712

Uncentered R2 = 0.9000

Schooling	Coefficient	Std. Error	t	P>t	[95% Confidence Interval]	
Age	0.239	0.047	5.06	0.000	0.146	0.331
Age squared	-0.004	0.0007	-5.57	0.000	-0.005	-0.003
Tenure	-0.02	0.023	-0.85	0.396	-0.065	0.026
Tenure squared	7.53e-06	0.001	0.01	0.992	-0.001	0.001
Mauritian	1.064	0.467	2.28	0.023	.1487	1.979
Rural areas	-1.112	0.129	-8.66	0.000	-1.365	-0.861
Free secondary schooling	-0.420	0.287	-1.46	0.144	-0.983	0.143
Constant	5.975	0.86	6.95	0.000	4.289	7.661

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Partial R-squared of excluded instruments: 0.0009

Test of excluded instruments:

F(1, 2272) = 2.14

Prob > F = 0.1439

Summary results for first-stage regressions:

Variable	Shea Partial R2	Partial R2	F(1, 2272)	P-value
Schooling	0.0009	0.0009	2.14	0.1439

Instrumental variables (2SLS) regression

Number of observations = 2280

F(7, 2272) = 59.51

Prob > F = 0.0000

Total (centered) SS = 727.6721205 Centered R2 = 0.2378

Total (uncentered) SS = 25335.84928 Uncentered R2 = 0.9781

Logarithm of gross earnings	**Coefficient**	**Std. Error**	**z**	**P>z**	**[95% Confidence Interval]**	
Schooling	0.057	0.112	0.50	0.614	-0.164	0.277
Age	0.049	0.025	1.86	0.063	-0.003	0.094
Age squared	-0.0005	0.0004	-1.19	0.236	-0.001	0.0003
Tenure	0.017	0.004	4.02	0.000	0.009	0.026
Tenure squared	-0.0002	0.0001	-1.97	0.049	-0.0005	-1.01e-06
Mauritian	0.256	0.141	1.83	0.068	-0.019	0.530
Rural areas	-0.067	0.128	-0.53	0.599	-0.317	0.183
Constant	1.482	0.680	2.18	0.029	0.149	2.814

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Sargan statistic (overidentification test of all instruments): 0.000

(equation exactly identified)

Tests of endogeneity of: Schooling

H_0: Regressor is exogenous

Wu-Hausman F test: 0.00048 F(1,2271) P-value = 0.98251

Durbin-Wu-Hausman chi-sq test: 0.00048 Chi-sq(1) P-value = 0.98248

8. IV procedure using the instrument 'free secondary education' for Public sector male employees only

First-stage regression of Schooling:

Ordinary Least Squares (OLS) regression

Number of observations = 625

F(7, 617) = 19.11

Prob > F = 0.0000

Centered R2 = 0.1781

Uncentered R2 = 0.9257

Schooling	Coefficient	Std. Error	t	P>t	[95% Confidence Interval]	
Age	-0.339	0.14	-2.42	0.016	-0.612	-0.063
Age squared	0.002	0.002	1.40	0.161	-0.001	0.006
Tenure	0.072	0.056	1.29	0.198	-0.038	0.182
Tenure squared	-0.002	0.002	-1.16	0.247	-0.005	0.001
Mauritian	-5.60	3.06	-1.83	0.068	-11.608	0.410
Rural areas	-.7116	0.248	-2.87	0.004	-1.197	-0.225
Free secondary schooling	0.393	0.456	0.86	0.389	-0.502	1.287
Constant	25.393	4.191	6.06	0.000	17.163	33.623

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Partial R-squared of excluded instruments: 0.0012

Test of excluded instruments:

F(1, 617) = 0.74

Prob > F = 0.3894

Summary results for first-stage regressions:

Variable Shea Partial R2 Partial R2 F(1, 617) P-value

Schooling 0.0012 0.0012 0.74 0.3894

Number of observations = 625

F(7, 617) = 9.68

Prob > F = 0.0000

Total (centered) SS = 145.5784684 Centered R2 = 0.0350

Total (uncentered) SS = 9108.900295 Uncentered R2 = 0.9846

Logarithm of gross earnings	**Coefficient**	**Std. Error**	**z**	**P>z**	**[95% Confidence**	**Interval]**
Schooling	-0.010	0.182	-0.05	0.956	-0.366	0.347
Age	0.006	0.065	0.09	0.928	-0.122	0.133
Age squared	-0.0002	0.0005	-0.34	0.731	-0.001	0.001
Tenure	0.029	0.015	1.88	0.060	-0.001	0.059
Tenure squared	-0.0004	0.0004	-0.89	0.374	-0.001	0.0004
Mauritian	-1.227	1.136	-1.08	0.280	-3.452	0.998
Rural areas	-0.138	0.134	-1.02	0.306	-0.401	0.126
Constant	4.904	4.779	1.03	0.305	-4.463	14.270

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Sargan statistic (overidentification test of all instruments): 0.000

(equation exactly identified)

Tests of endogeneity of: Schooling

H_0: Regressor is exogenous

Wu-Hausman F test: 0.44654 F(1,616) P-value = 0.50423

Durbin-Wu-Hausman chi-sq test: 0.45274 Chi-sq(1) P-value = 0.50104

9. V procedure using the instrument 'free secondary education' for private sector female employees only

First-stage regression of Schooling:

Ordinary Least Squares (OLS) regression

Number of observations = 1156

F(7, 1148) = 87.74

Prob > F = 0.0000

Centered R2 = 0.3485

Uncentered R2 = 0.8859

Schooling	Coefficient	Std. Error	t	P>t	[95% Confidence Interval]	
Age	0.124	0.070	1.78	0.076	-0.013	0.26
Age squared	-0.003	0.001	-2.98	0.003	-0.005	-0.001
Tenure	-0.003	0.038	-0.07	0.942	-0.077	0.071
Tenure squared	-0.0003	0.001	-0.22	0.826	-0.003	0.002
Mauritian	-3.187	0.468	-6.81	0.000	-4.105	-2.27
Rural areas	-2.30	0.192	-11.98	0.000	-2.672	-1.92
Free secondary schooling	1.527	0.440	3.47	0.001	0.663	2.39
Constant	11.764	1.162	10.13	0.000	9.485	14.044

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Partial R-squared of excluded instruments: 0.0104

Test of excluded instruments:

F(1, 1148) = 12.04

Prob > F = 0.0005

Summary results for first-stage regressions:

Variable	Shea Partial R2	Partial R2	F(1, 1148)	P-value
Schooling	0.0104	0.0104	12.04	0.0005

Instrumental variables (2SLS) regression

Number of observations = 1156

F(7, 1148) = 25.93

Prob > F = 0.0000

Total (centered) SS = 440.2910932 Centered R2 = 0.0481

Total (uncentered) SS = 10517.91803 Uncentered R2 = 0.9602

Logarithm of gross earnings	**Coefficient**	**Std. Error**	**z**	**P>z**	**[95% Confidence Interval]**	
Schooling	0.166	0.054	3.08	0.002	0.060	0.271
Age	0.003	0.017	0.17	0.863	-0.030	0.036
Age squared	0.0003	0.0003	0.81	0.418	-0.0004	0.001
Tenure	0.029	0.007	4.11	0.000	0.015	0.043
Tenure squared	-0.0001	0.0002	-0.47	0.639	-0.0006	0.0004
Mauritian	0.756	0.191	3.95	0.000	0.381	1.130
Rural areas	0.08	0.13	0.61	0.541	-0.175	0.334
Constant	0.123	0.684	0.18	0.857	-1.217	1.463

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Sargan statistic (overidentification test of all instruments): 0.000

(equation exactly identified)

Tests of endogeneity of: Schooling

H_0: Regressor is exogenous

Wu-Hausman F test: 4.03968 F(1,1147) P-value = 0.04468

Durbin-Wu-Hausman chi-sq test: 4.05709 Chi-sq(1) P-value = 0.04399

10. IV procedure using the instrument 'free secondary education' for Public sector female employees only

First-stage regression of Schooling:

Ordinary Least Squares (OLS) regression

Number of observations = 195

F(7, 187) = 21.87

Prob > F = 0.0000

Total (centered) SS = 1960.133333 Centered R2 = 0.4502

Total (uncentered) SS = 31302 Uncentered R2 = 0.9656

Schooling	Coefficient	Std. Error	t	P>t	[95% Confidence Interval]	
Age	0.561	0.164	3.41	0.001	0.237	0.885
Age squared	-0.010	0.002	-4.80	0.000	-0.015	-0.006
Tenure	-0.097	0.090	-1.07	0.285	-0.275	0.081
Tenure squared	0.007	0.003	2.57	0.011	0.002	0.012
Mauritian	-3.236	2.484	-1.30	0.194	-8.136	1.663
Rural areas	-0.77	0.363	-2.12	0.035	-1.485	-0.054
Free secondary schooling	0.598	0.715	0.84	0.404	-0.812	2.009
Constant	9.574	4.064	2.36	0.020	1.558	17.591

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Partial R-squared of excluded instruments: 0.0037

Test of excluded instruments:

F(1, 187) = 0.70

Prob > F = 0.4039

Summary results for first-stage regressions:

Variable	Shea Partial R2	Partial R2	F(1, 187)	P-value
Schooling	0.0037	0.0037	0.70	0.4039

Instrumental variables (2SLS) regression

Number of observations = 195

F(7, 187) = 12.54

Prob > F = 0.0000

Total (centered) SS = 50.15698776 Centered R2 = 0.2390

Total (uncentered) SS = 3071.190832 Uncentered R2 = 0.9876

Logarithm of gross earnings	**Coefficient**	**Std. Error**	**z**	**P>z**	**[95% Confidence Interval]**	
Schooling	-0.026	0.220	-0.12	0.906	-0.458	0.406
Age	0.137	0.131	1.05	0.296	-0.120	0.394
Age squared	-0.002	0.002	-0.88	0.380	-0.007	0.003
Tenure	0.006	0.026	0.21	0.834	-0.046	0.057
Tenure squared	0.001	0.002	0.77	0.444	-0.002	0.004
Mauritian	-0.98	0.863	-1.14	0.256	-2.671	0.712
Rural areas	-0.120	0.183	-0.66	0.511	-0.479	0.238
Constant	3.003	2.35	1.28	0.201	-1.603	7.609

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Sargan statistic (overidentification test of all instruments): 0.000

(equation exactly identified)

Tests of endogeneity of: Schooling

H_0: Regressor is exogenous

Wu-Hausman F test: 0.45629 F(1,186) P-value = 0.50020

Durbin-Wu-Hausman chi-sq test: 0.47719 Chi-sq(1) P-value = 0.48970

11. IV procedure using the instrument 'free secondary education' for rural residents only (both sexes)

First-stage regression of Schooling:

Ordinary Least Squares (OLS) regression

Number of observations = 2434

F(8, 2425) = 85.00

Prob > F = 0.0000

Centered R2 = 0.2190

Uncentered R2 = 0.8864

Schooling	**Coefficient**	**Std. Error**	**t**	**P>t**	**[95% Confidence Interval]**	
Age	0.237	0.05	4.78	0.000	0.14	0.334
Age squared	-0.005	0.0007	-6.10	0.000	-0.006	-0.003
Tenure	-0.049	0.024	-2.04	0.041	-0.096	-0.002
Tenure squared	0.001	0.0007	1.36	0.174	-0.0004	0.002
Mauritian	-0.604	0.412	-1.46	0.143	-1.412	0.205
Public sector	3.087	0.176	17.50	0.000	2.741	3.433
Female	-0.558	0.145	-3.85	0.000	-0.841	-0.274
Free secondary schooling	0.350	0.286	1.22	0.222	-0.211	0.910
Constant	6.676	0.890	7.50	0.000	4.93	8.421

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Partial R-squared of excluded instruments: 0.0006

Test of excluded instruments:

F(1, 2425) = 1.49

Prob > F = 0.2219

Summary results for first-stage regressions:

Variable	Shea Partial R2	Partial R2	F(1, 2425)	P-value
Schooling	0.0006	0.0006	1.49	0.2219

Instrumental variables (2SLS) regression

Number of observations = 2434

F(8, 2425) = 118.48

Prob > F = 0.0000

Total (centered) SS = 876.4586656 Centered R2 = 0.1974

Total (uncentered) SS = 26002.737 Uncentered R2 = 0.9729

Logarithm of gross earnings	**Coefficient**	**Std. Error**	**z**	**P>z**	**[95% Confidence Interval]**	
Schooling	0.135	0.139	0.97	0.332	-0.138	0.408
Age	0.012	0.037	0.32	0.751	-0.061	0.085
Age squared	0.0001	0.0007	0.07	0.941	-0.001	0.001
Tenure	0.027	0.008	3.38	0.001	0.011	0.043
Tenure squared	-0.0004	0.0002	-2.02	0.043	-0.001	-0.00001
Mauritian	0.474	0.109	4.36	0.000	0.261	0.686
Public sector	0.067	0.429	0.16	0.877	-0.775	0.908
Female	-0.218	0.081	-2.68	0.007	-0.378	-0.059
Constant	0.962	0.952	1.01	0.312	-0.903	2.828

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Sargan statistic (overidentification test of all instruments): 0.000

(equation exactly identified)

Tests of endogeneity of: Schooling

H_0: Regressor is exogenous

Wu-Hausman F test: 0.46480 F(1,2424) P-value = 0.49546

Durbin-Wu-Hausman chi-sq test: 0.46663 Chi-sq(1) P-value = 0.49454

12. IV procedure using the instrument 'free secondary education' for male rural residents only

First-stage regression of Schooling:

Ordinary Least Squares (OLS) regression

Number of observations = 1699

F(7, 1691) = 41.33

Prob > F = 0.0000

Centered R2 = 0.1461

Uncentered R2 = 0.9004

Schooling	Coefficient	Std. Error	t	P>t	[95% Confidence Interval]	
Age	0.21	0.059	3.56	0.000	0.094	0.326
Age squared	-0.004	0.001	-4.16	0.000	-0.005	-0.002
Tenure	-0.038	0.027	-1.40	0.161	-0.092	0.015
Tenure squared	-0.00002	0.001	-0.02	0.984	-0.002	0.002
Mauritian	2.221	0.559	3.98	0.000	1.126	3.317
Public sector	2.457	0.190	12.90	0.000	2.084	2.83
Free secondary schooling	-0.109	0.323	-0.34	0.736	-0.742	0.524
Constant	4.257	1.076	3.96	0.000	2.147	6.367

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Partial R-squared of excluded instruments: 0.0001

Test of excluded instruments:

F(1, 1691) = 0.11

Prob > F = 0.7355

Summary results for first-stage regressions:

Variable	Shea Partial R2	Partial R2	F(1, 1691)	P-value
Schooling	0.0001	0.0001	0.11	0.7355

Instrumental variables (2SLS) regression

Number of observations = 1699

F(7, 1691) = 69.35

Prob > F = 0.0000

Total (centered) SS = 529.6382923 Centered R2 = 0.1922

Total (uncentered) SS = 19417.80218 Uncentered R2 = 0.9780

Logarithm of gross earnings	**Coefficient**	**Std. Error**	**z**	**P>z**	**[95% Confidence Interval]**	
Schooling	0.117	0.497	0.24	0.814	-0.856	1.091
Age	0.042	0.101	0.41	0.680	-0.156	0.239
Age squared	-0.0004	0.002	-0.24	0.811	-0.004	0.003
Tenure	0.019	0.02	1.00	0.317	-0.019	0.057
Tenure squared	-0.0001	0.0001	-0.87	0.386	-0.0004	0.0002
Mauritian	0.221	1.105	0.20	0.841	-1.944	2.386
Public sector	0.073	1.223	0.06	0.953	-2.325	2.470
Constant	0.983	2.115	0.46	0.642	-3.162	5.128

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Sargan statistic (overidentification test of all instruments): 0.000

(equation exactly identified)

Tests of endogeneity of: Schooling

H_0: Regressor is exogenous

Wu-Hausman F test: 0.01967 F(1,1690) P-value = 0.88847

Durbin-Wu-Hausman chi-sq test: 0.01978 Chi-sq(1) P-value = 0.88816

13. IV procedure using the instrument 'free secondary education' for male urban residents only

First-stage regression of Schooling:

Ordinary Least Squares (OLS) regression

Number of observations = 1206

F(7, 1198) = 11.29

Prob > F = 0.0000

Centered R2 = 0.0619

Uncentered R2 = 0.9142

Schooling	**Coefficient**	**Std. Error**	**t**	**P>t**	**[95% Confidence Interval]**	
Age	0.222	0.064	3.48	0.001	0.097	0.347
Age squared	-0.004	0.001	-3.82	0.000	-0.005	-0.002
Tenure	-0.011	0.034	-0.34	0.733	-0.077	0.055
Tenure squared	0.0006	0.001	0.56	0.576	-0.002	0.003
Mauritian	-1.555	0.821	-1.89	0.058	-3.167	0.055
Public sector	1.46	0.232	6.30	0.000	1.005	1.915
Free secondary schooling	0.118	0.363	0.33	0.745	-0.593	0.829
Constant	7.975	1.308	6.10	0.000	5.408	10.541

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Partial R-squared of excluded instruments: 0.0001

Test of excluded instruments:

F(1, 1198) = 0.11

Prob > F = 0.7450

Summary results for first-stage regressions:

Variable	Shea Partial R2	Partial R2	F(1, 1198)	P-value
Schooling	0.0001	0.0001	0.11	0.7450

Instrumental variables (2SLS) regression

Number of observations = 1206

F(7, 1198) = 58.60

Prob > F = 0.0000

Total (centered) SS = 452.8555945 Centered R2 = 0.3132

Total (uncentered) SS = 15026.94739 Uncentered R2 = 0.9793

Logarithm of gross earnings	**Coefficient**	**Std. Error**	**z**	**P>z**	**[95% Confidence Interval]**	
Schooling	0.023	0.515	0.04	0.964	-0.986	1.032
Age	0.047	0.118	0.40	0.686	-0.183	0.279
Age squared	-0.001	0.002	-0.25	0.803	-0.004	0.003
Tenure	0.016	0.008	1.94	0.053	-0.0002	0.033
Tenure squared	-0.0002	0.0004	-0.54	0.589	-0.001	0.001
Mauritian	-0.08	0.808	-0.10	0.922	-1.664	1.505
Public sector	0.274	0.751	0.36	0.715	-1.197	1.745
Constant	2.077	4.14	0.50	0.615	-6.027	10.182

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Sargan statistic (overidentification test of all instruments): 0.000

(equation exactly identified)

Tests of endogeneity of: Schooling

H_0: Regressor is exogenous

Wu-Hausman F test: 0.01444 F(1,1197) P-value = 0.90436

Durbin-Wu-Hausman chi-sq test: 0.01455 Chi-sq(1) P-value = 0.90398

14. IV procedure using the instrument 'free secondary education' for female rural residents only

First-stage regression of Schooling:

Ordinary Least Squares (OLS) regression

Number of observations = 735

F(7, 727) = 71.98

Prob > F = 0.0000

Centered R2 = 0.4093

Uncentered R2 = 0.8747

Schooling	**Coefficient**	**Std. Error**	**t**	**P>t**	**[95% Confidence Interval]**	
Age	0.144	0.087	1.66	0.098	-0.026	0.314
Age squared	-0.003	0.001	-2.71	0.007	-0.006	-0.001
Tenure	-0.017	0.047	-0.37	0.710	-0.11	0.075
Tenure squared	-0.001	0.002	-0.70	0.482	-0.004	0.002
Mauritian	-3.108	0.595	-5.13	0.000	-4.276	-1.94
Public sector	4.612	0.386	11.96	0.000	3.855	5.37
Free secondary schooling	1.443	0.547	2.64	0.008	0.37	2.517
Constant	9.471	1.502	6.30	0.000	6.522	12.420

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Partial R-squared of excluded instruments: 0.0095

Test of excluded instruments:

F(1, 727) = 6.97

Prob > F = 0.0085

Summary results for first-stage regressions:

Variable	Shea Partial R2	Partial R2	F(1, 727)	P-value
Schooling	0.0095	0.0095	6.97	0.0085

Instrumental variables (2SLS) regression

Number of observations = 735

F(7, 727) = 59.62

Prob > F = 0.0000

Total (centered) SS = 264.0340737 Centered R2 = 0.3966

Total (uncentered) SS = 6584.934821 Uncentered R2 = 0.9758

Logarithm of gross earnings	**Coefficient**	**Std. Error**	**z**	**P>z**	**[95% Confidence Interval]**	
Schooling	0.075	0.054	1.38	0.167	-0.031	0.182
Age	-0.001	0.017	-0.07	0.944	-0.035	0.032
Age squared	0.0002	0.0003	0.47	0.639	-0.001	0.001
Tenure	0.027	0.007	3.96	0.000	0.014	0.041
Tenure squared	-0.0002	0.0002	-0.89	0.374	-0.001	0.0002
Mauritian	0.504	0.189	2.66	0.008	0.133	0.875
Public sector	0.550	0.257	2.14	0.032	0.047	1.054
Constant	1.441	0.579	2.49	0.013	0.307	2.575

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Sargan statistic (overidentification test of all instruments): 0.000

(equation exactly identified)

Tests of endogeneity of: Schooling

H_0: Regressor is exogenous

Wu-Hausman F test: 0.23136 F(1,726) P-value = 0.63066

Durbin-Wu-Hausman chi-sq test: 0.23415 Chi-sq(1) P-value = 0.62846

15. IV procedure using the instrument 'free secondary education' for female urban residents only

First-stage regression of Schooling:

Ordinary Least Squares (OLS) regression

Number of observations = 616

F(7, 608) = 40.58

Prob > F = 0.0000

Centered R2 = 0.3184

Uncentered R2 = 0.9301

Schooling	Coefficient	Std. Error	T	P>t	[95% Confidence Interval]	
Age	0.206	0.092	2.24	0.025	0.026	0.386
Age squared	-0.004	0.001	-3.30	0.001	-0.007	-0.002
Tenure	-0.017	0.049	-0.34	0.734	-0.114	0.080
Tenure squared	0.003	0.002	1.80	0.073	-0.0003	0.006
Mauritian	-3.213	0.682	-4.71	0.000	-4.552	-1.874
Public sector	2.715	0.337	8.07	0.000	2.054	3.376
Free secondary schooling	1.10	0.533	2.06	0.040	0.052	2.148
Constant	10.802	1.517	7.12	0.000	7.823	13.782

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Partial R-squared of excluded instruments: 0.0070

Test of excluded instruments:

F(1, 608) = 4.26

Prob > F = 0.0395

Summary results for first-stage regressions:

Variable	Shea Partial R2	Partial R2	F(1, 608)	P-value
Schooling	0.0070	0.0070	4.26	0.0395

Instrumental variables (2SLS) regression

Number of observations = 616

F(7, 608) = 33.82

Prob > F = 0.0000

Total (centered) SS = 345.5109061 Centered R2 = 0.1546

Total (uncentered) SS = 7004.174038 Uncentered R2 = 0.9583

Logarithm of gross earnings	**Coefficient**	**Std. Error**	**z**	**P>z**	**[95% Confidence Interval]**	
Schooling	0.266	0.114	2.34	0.019	0.043	0.489
Age	0.019	0.038	0.51	0.612	-0.055	0.093
Age squared	0.0002	0.001	0.29	0.770	-0.001	0.002
Tenure	0.026	0.012	2.24	0.025	0.003	0.049
Tenure squared	-0.0004	0.0005	-0.74	0.461	-0.001	0.001
Mauritian	0.924	0.395	2.34	0.019	0.149	1.699
Public sector	-0.052	0.316	-0.16	0.870	-0.671	0.567
Constant	-1.493	1.299	-1.15	0.250	-4.039	1.053

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

Sargan statistic (overidentification test of all instruments): 0.000

(equation exactly identified)

Tests of endogeneity of: Schooling

H_0: Regressor is exogenous

Wu-Hausman F test: 3.16468 F(1,607) P-value = 0.07575

Durbin-Wu-Hausman chi-sq test: 3.19495 Chi-sq(1) P-value = 0.07387

Appendix D: Nature of the Sample

Number of men & women combined by qualification level & by age

Age years	No school / primary schooling	Lower secondary	Upper secondary	GCSE & 6th form	A level	Vocational education	Tertiary education	Total
12	1	0	0	0	0	0	0	1
13	1	0	0	0	0	0	0	1
14	4	0	0	0	0	0	0	4
15	6	2	1	0	0	0	0	9
16	19	3	2	0	0	0	0	24
17	13	2	3	1	0	0	1	20
18	24	12	9	3	1	0	0	49
19	28	12	19	6	4	0	1	70
20	30	20	24	20	14	2	0	110
21	42	15	21	21	13	2	0	114
22	36	17	25	14	15	2	1	110
23	44	10	22	12	12	3	5	108
24	44	16	30	12	17	2	6	127
25	50	16	20	22	17	0	9	134
26	29	9	16	16	12	4	2	88
27	42	22	27	23	14	7	6	141
28	45	9	32	17	17	10	4	134
29	33	14	35	12	10	5	2	111
30	35	8	38	13	11	4	5	114
31	40	15	30	17	9	2	5	118
32	68	14	34	19	13	2	1	151
33	44	10	18	20	12	6	2	112
34	60	15	25	22	10	2	4	138
35	48	21	33	25	7	9	9	152
36	45	22	40	24	6	3	3	143
37	40	19	19	19	15	1	3	116
38	64	19	27	31	7	2	3	153
39	51	17	23	16	6	0	6	119
40	60	16	17	27	3	3	3	129
41	63	12	21	21	9	5	6	137
42	59	11	14	22	4	0	0	110
43	58	14	19	15	3	3	2	114
44	50	8	16	20	3	8	3	108
45	46	11	11	19	0	3	3	93
46	47	5	9	22	7	1	3	94
47	58	12	12	11	5	2	3	103
48	52	9	9	12	3	4	5	94
49	70	14	15	20	2	2	0	123
50	60	4	10	14	0	0	0	88
51	38	5	10	6	0	2	3	64
52	36	7	6	8	0	1	0	58
53	31	3	3	7	1	1	1	47
54	30	4	8	11	1	3	2	59
55	29	2	3	5	1	1	0	41
56	38	2	7	7	0	1	0	55
57	18	3	3	5	1	0	1	31
58	24	1	5	3	1	1	0	35
59	12	2	2	1	0	0	1	18
Total	1,865	484	773	641	286	109	114	4,272

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

1. Number of men & women combined by qualification level and by gender

Qualification levels	Male	Female	Total
No schooling or at most primary schooling	1,291	574	1,865
Lower secondary	352	132	484
Upper secondary	567	206	773
GCSE & sixth form	410	231	641
A level	151	135	286
Vocational education	72	37	109
Tertiary education	77	37	114
Total	2,920	1,352	4,272

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

2. Number of men & women combined by qualification level and by sector of employment

Qualification levels	Private sector	Public sector	Total
No schooling or at most primary schooling	1,667	198	1,865
Lower secondary	430	54	484
Upper secondary	653	120	773
GCSE & sixth form	420	221	641
A level	164	122	286
Vocational education	50	59	109
Tertiary education	68	46	114
Total	3,452	820	4,272

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

3. Number of men only by qualification level and by sector

Qualification levels	private sector	public sector	Total
No schooling or at most primary schooling	1,113	178	1,291
Lower secondary	303	49	352
Upper secondary	460	107	567
GCSE & sixth form	252	158	410
A level	89	62	151
Vocational education	32	40	72
Tertiary education	46	31	77
Total	2,295	625	2,920

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

4. Number of women only by qualification level and by sector

Qualification levels	Private sector	Public sector	Total
No schooling or at most primary schooling	554	20	574
Lower secondary	127	5	132
Upper secondary	193	13	206
GCSE & sixth form	168	63	231
A level	75	60	135
Vocational education	18	19	37
Tertiary education	22	15	37
Total	1,157	195	1,352

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

5. Number of men & women combined by qualification level and by area of location

Qualification levels	Urban areas	Rural areas	Total
No schooling or at most primary schooling	614	1,251	1,865
Lower secondary	245	239	484
Upper secondary	332	441	773
GCSE & sixth form	333	308	641
A level	163	123	286
Vocational education	65	44	109
Tertiary education	77	37	114
Total	1,829	2,443	4,272

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

6. Number of men only by qualification level and by area of location

Qualification levels	Urban areas	Rural areas	Total
No schooling or at most primary schooling	435	856	1,291
Lower secondary	174	178	352
Upper secondary	250	317	567
GCSE & sixth form	195	215	410
A level	72	79	151
Vocational education	38	34	72
Tertiary education	49	28	77
Total	1,213	1,707	2,920

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius

7. Number of women only by qualification level & by area of location

Qualification levels	**Urban areas**	**Rural areas**	**Total**
No schooling or at most primary schooling	179	395	574
Lower secondary	71	61	132
Upper secondary	82	124	206
GCSE & sixth form	138	93	231
A level	91	44	135
Vocational education	27	10	37
Tertiary education	28	9	37
Total	616	736	1,352

Source: Computed from 2000 Population Census Data, CSO, Republic of Mauritius